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The preservation of the Falls of St. Anthony was undertaken by the United States in 1870, since which time the government has expended upon this work $600,000 in extensive and costly structures and repairs. The plea for this expenditure was that the destruction of the falls would be followed by the destruction of navigation on the Mississippi river above them. There has not been, however, any navigation by steamboats between the falls and St. Cloud, about seventy-miles above Minneapolis, for several years past. For many years past the mill and water power companies, chartered in 1857, have occupied the bed of the river above the crest of the falls by dams and other structures for the development and use of the power of the stream, thereby contracting the waterway to about one-third its original (natural) width. The flood, as well as low water, volumes are thus forced through a narrow gorge of about four hundred and fifty feet in width, diminishing on account of the forced construction of the wing to a width of about three hundred and fifty feet, and through a fall of forty to fifty feet, vertical distance, the height depending upon stage of water, operation of the gates of the mills, etc. The eroding power of volumes of water of from five to forty thousand cubic feet per second, plunging through heights of forty to fifty feet upon the sand rock composing the bed of the river below the falls, is immense. The recession of the limestone crest from 1857 to 1868 was (measured along the axis of the stream) 325 feet. An attempt by private parties in 1868 to tunnel through the sand rock under the limestone, on the east side, was followed by such disasters and breaks in the ledge that the very existence of the falls was threatened. The danger proving too formidable for individuals or corporations to cope with, the assistance of congress was invoked. Some of the dams and works pertaining to the mills are dilapidated and leaky. Should their condition not be improved there is a possibility of ice and logs going over or through them in the spring, or at times of floods, to the further detriment of the apron and the east wing. The attempt to tunnel under what is known as Farnham & Lovejoy's millpond in 1881—82, at a point about fifty feet below the United States works, progressed far enough to expose a small face of the sand rock to the action of high water, and the erosion has, since the winter of 1882, caused a recession of the limestone ledge at this point of probably forty feet. As this recession approaches the United States works the latter are more and more endangered. Bearing in mind the difficulty, under the most favorable of circumstances attending the efforts of the government to preserve the falls, it has seemed proper to make the foregoing statement.

The engineer also reports that the dams in the river above the falls have also been broken and injured by private parties, but that satisfactory evidence could not be produced against the guilty parties.—*Pioneer Press.*

SUING FOR $100,000 DAMAGES.—PHILADELPHIA, July 28.—Strawbridge & Taylor, counsel for Edward Cooper and Abram S. Hewitt, of New York, have brought a suit in the United States Circuit Court claiming $100,000 damages from the Pennsylvania Steel Company for the alleged infringement of letters patent of the United States granted to Emil Martin and Pierre E. Martin, of Paris, France, for an improved process for refining and converting cast-iron into cast steel.

The New York Underground Wire Commission.

The commission appointed to compel the telegraph, telephone and electric light companies to take down their poles and place their wires under ground, in New York, held its first meeting for organization at the Metropolitan Hotel, on July 20th. The commissioners are Charles E. Loew, President of the Iron Steamboat Company; Theodore Moss, Treasurer of Wallack's Theater, and ex-Commissioner of Charities and Correction, Jacob Hess. Mr. Hess called the meeting to order, and nominated for president Mr. Loew, who was unanimously elected. Mr. Moss was appointed secretary, and F. A. Lovecraft assistant secretary.

The commission having thus organized for business, President Loew offered a long preamble and resolution, declaring that under the law it was the duty of the commission to cause all telegraphic, telephonic, and electric light wires to be put under ground, and that the commission proposed to do the work for which it was appointed as speedily as possible. The law requires that plans and maps, with estimates of cost, shall be filed by the companies with the board within 60 days after its passage, or before Aug. 14; and if they do not do this the commission is authorized to adopt a plan of its own. It is the purpose of this board, the preamble says, to cause the wires to be placed under ground, and the secretary is instructed to notify all persons or companies owning or controlling the wires above ground, that the board will receive at the Metropolitan Hotel any plans, maps, or methods proposed for its approval; and that it requests that such plans be submitted as soon as practicable before the expiration of the 60 days prescribed in the law. The resolution was passed. The following, proposed by Mr. Hess, was also adopted:

Resolved, That the owners, lessees, or occupants of houses be requested to refuse permission for the placing of any telegraphic, telephonic, or electric wires over or on their respective buildings, without first securing a permit from this board.

Another resolution offered by Mr. Hess, requesting the companies to offer to the board at its next meeting any plans which they may have for placing new wires above ground, was passed, and the commission adjourned until Monday. In the meantime an office will be secured, and the commission will meet daily after that.

Railways in Japan.

The total length of railways now open in Japan is 240 miles, the first line opened being that between Tokio and Yokohama, which is 20 miles in length, and was opened in 1872. This line, which has five intermediate stations, cost nearly £600,000, and was constructed by English engineers. The line between Hiogo and Osaka was opened in 1874, but it has since been lengthened at both ends, and now runs from Kobe to Otsu, having a total length of more than 60 miles, and cost 7,000,000 yen. This line, which has 16 intermediate stations traverses the wealthiest provinces of the centre of Japan, and among the numerous articles which it conveys to Kobe and Osaka are silk, tea, cotton, rice, wheat, wadding, and cotton goods. It also carries inland the articles imported from abroad and the native goods sent by sea to Kobe. This line which stops short at Otsu, begins again at Nagahama, a town upon the opposite shore of Lake Biwa, and runs to the port of Tsuruga, upon the sea of Japan. The distance between the two places is 27 miles. This line was opened for trafic in 1882, so that the whole of this part of Japan can be traversed by railway, except for the break at Lake Biwa, a service of steamers plying between the two termini.

A third line has been constructed between Nagahama and Sekigahora Ohogaki, its total length being 57 miles. The terminus of Ohogaki, to which the line was extended on the 25th of May, is the centre of the province of Mino, which is one of the busiest and most productive in Japan. The fourth line open is that which connects Tokio and Takasaki. The line was not commenced until June, 1882, but by July of the following year the trains were already running as far as Kumagai, which is 38 miles from the capital, and the line was completed to Takasaki this spring, when the Emperor opened it in person. The length of this line is about 62 miles, and it brings to Tokio large quantities of, silk, tea, and tobacco from the different provinces. Two other lines are in course of construction; the first running from Shinagawa, upon the line from Tokio to Yokohama, to Kawagutchi, and the other from Takasaki to Mayebashi, one of the principal centres of the silk trade. The latter, only seven miles long will be opened this autumn.

Five other lines are about to be commenced: First, from Urawa, upon the Tokio and Takasaki line, to Aomori, a town at the northernmost point of the island of Niphon (length 450 miles); second, from Takasaki to Ohogaki and Yokkaitchi (length 200 miles); third, from Oneyda, in the province of Shinano, to Niigata (length 150 miles); fourth, from Osaka to Sakai (seven miles); and fifth, from Shizonoka to Shimidzu, in the province of Tesuruga (seven miles). A tramway from Tokio to Kofu will also be made without delay.

Proposed Drainage Regulations.

The following excellent regulations have been proposed for the city of Glasgow, Scotland: 1. The positions and sizes of all drains, pipes, cesspools, or traps, and all soil and rain-water pipes and conductors shall be shown distinctly upon the plans submitted, and the weights per foot of the lead or iron soil-pipes, conductors and cesspools be marked on the plans in figures. 2. Forty-eight hours' notice must be given to the Master of Works, at his office, previous to commencing the laying of any drains. The party giving the notice will receive a card of permission to open the street, which card will be held as proof of the notice having been given. 3. All connection between drains and the public sewer will be made by workmen of the statute labor department, and shall be paid for by the proprietor. 4. Every drain-pipe must have a uniform fall of not less than one inch to every lineal yard, and every pipe must be thoroughly packed and resting entirely on the solid earth. When the Master of Works deems it advisable, he shall require concrete foundations to be put under and around the drain pipes. 5. The joints must be well cemented and all cement projecting on the inside must be removed. 6. Sufficient traps and ventilation must be provided for, and fixed to the satisfaction of the Master of Works. 7. Before covering, all pipes must be inspected by the Master, or his representative, and no junction connecting drain-pipes and plumber-work to be covered up until examined and passed by him. 8. The Master of Works to have power to use the smoke-test on all drains and plumber-work before the building is occupied, and at any other time he may consider necessary, all expenses connected with the test to be paid by the owner of the property. 9. No dwelling shall be occupied until the Master of Works has given a certificate that the drains and cesspools with traps, have been properly constructed, and the house otherwise fit for occupation. 10. Proprietors and contractors will give every assistance to the master of works, for the purpose of performing the necessary inspection.

ton and Western, main, $6,700; side, $2,000; rolling stock, $2,5000; improvements, $0,880. Indianapolis, Decatur and Springfield, main, $5,000; side, $2,000; rolling stock, $1,450; improvements, $30,900. Lake Erie and Western, main, $6,000; side, $2,000; rolling stock, $1,400; improvements, $16,725. Lake Shore and Michigan Southern, main, $20,000; side, $3,000; rolling stock, $3,300; improvements, $110,345. Louisville, Evansville and St. Louis, main, $4,000; side, $2,000; rolling stock, $1,200; improvements, $17,785. Louisville, New Albany and Chicago, main, $5,000; rolling stock, $1,500; improvements, $4,350 New York, Chicago and St. Louis, main, $6,000; side; $2,000; rolling stock, $3,600; improvements, $27,485. Ohio and Mississippi, main, $9,000; side, $2,500; rolling stock, $1,700; improvements, $10,505. Pennsylvania Company, operating Pittsburg, Fort Wayne and Chicago, main, $20,000; side, $6,000; rolling stock, $4,600; improvements, $176,410. Jeffersenville, Madison and Indianapolis, main, $9,000; second $4,000; sidef $3,000; rolling stock $1,500; improvements, $40,550. Indianapolis and Vincennes, main, $4,000; side, $2,000; rolling stock, $900; improvements, 15,395. Terre Haute and Indianapolis, main, $13,000; side, $2,500; rolling stock, $900; improvements, $15,395. Terre Haute and Logansport Division, main, $3500; side $2,000; rolling stock, $800; improvements, $1,365. Wabash, St. Louis and Pacific, main, $13,000; side $2,500; rolling stock, $2,000; improvements, $134,045. Whitewater Valley, main. $3,000; side, $200; rolling stock, $400; improvements $3,300.

Index to Periodical Literature.

Artillery.—(*See* Cannon).

Blasting.—(*See* Harbor).

Blasting.—*Notes on Electric Blasting in China.*—Describes the operations on the works of Engineering and mining company of North China. Two descriptions of Siemens dynamo-exploders were found most suitable, but the Siemens fuses were abandoned for the Abel which is more durable. The gunpowder, cased in paper cartridges, was of native manufacture, and native labor was employed. The different forms of exploders, fuses, etc., are described and illustrated, as well as the mode of working, precautions and accidents. C. W. Kinder, A. M. I. C. E., *Min. Proc. Inst. C. E.*, vol. lxxx; *Session*, 1884-85.

Cannon.—An article descriptive of the new French gun brought out by Col. De Bange. It is composed of steel inner tube strengthened by a series of hoops put on hot; there are four layers of hoops at the breech, reducing to one layer at the muzzle. It is a breech-loader. 340 millimetres (13.25 inches) bore. The carriage is on a pivot and has a hydraulic brake, the trunnions are carried on a curved frame pivotted at the rear. The gun is 11.06 meters (36.-25 feet) long; it is described, in detail, with several drawings, and notes on the projectiles, and formulæ for its efficiency are also given. *Le Génie Civil*, July 4, 1885, pp. 145 to 147.

Dynamometers.—A paper read April 29, before the Engineers Club of St. Louis, by C. F. White, describes the construction and operation of several forms, especially of a new one lately brought out, the "Wales Portable Dynamometer," which is given in detail in formulæ for results, and a description of a trial for accuracy. Several illustrations, and two diagrams from the "Wales" machines. *Journal of the Assoc. of the Eng. Soc.* July, 1885, pp. 333 to 345.

Electric Blasting.—(*See* Blasting).

Elevator.—*Hydraulic Canal Elevator.*—On the Neufasse Canal, near St. Omer, France. There are two parallel troughs, closed with gates, each supported on a central ram, and are in equilibrium. They descend into a dry basin, the water being then let in and the barge floated out. Each trough is 40 metres (131 feet) long by 5.60 metres (18 ft. 6in.) wide, and has 2 feet depth of water. All the water for operating is taken from the upper canal so no fuel is required. The rams are 2 metres (6ft. 6in.) diam. and 13.13 metres (43 feet) stroke. Illustrated. A similar elevator at Anderton, England, is described. *Engineering*. July, 10, 1885, pp. 29 to 31.

Harbor.—*The Blasting and Removal of Rocks Under Water, and the Construction of a Deep Water Quay at Blyth Harbor (England.)* The material was rock, shale, and clay, the surface of the reef dry at low-water. Boring carried on from rafts, holes 2⅞ in. diam. Various explosives tried and gelatine found most suitable. Debris removed by a bucket dredge, a "Priestman" grab also employed. Whole cost of removal averaged $1.46 per cubic yard.

Quay.—Length 712 feet; height from floor to coping, 33 feet 6 inches; depth of low water 15 feet; high water 29 feet 6 inches. Batter 1 in 13. Timber piling and framing, and concrete wall. Piles 36 feet long, 13 inches square, iron shod, driven 5 feet into the rock. Planking fixed across face and liquid concrete deposited behind planking afterwards removed. The operations composition of concrete, quantities, and cost are given in detail, with plan and detail drawings. *Min. Proc. Inst. C. E.*, vol. lxxxi. Session 1884-85, part 3.

Locomotive.—A large engine for the Paulista Ry., Brazil Gauge 5 feet 3 inches. Inside cylinders 20 inch by 24 inch, valve chests outside Leading two-wheeled truck, four pairs coupled wheels 48 inch diameter. English construction, with plate-frames. Total weight 100,800 pounds. The tender has one pair of fixed wheels, and a four wheeled trailing truck. The nature of track and results of trials are given, with general and detail drawings. *Engineering*, July 10, 1885, pp. 34, 35.

Magnetism.—*Experiments on the Permanent Magnetism of Steel.*—The test bars were 100 by 20 by 20 millimetres (4 in. by ¾ by ¾). The electro-magnet and batteries are described, the Bunsen being found preferable to the Leclanchè. Several methods of ascertaining the magnetic power are described, the one adopted being given in detail and illustrated. Formulæ are given and a table showing the results from different bars. Experiments made at the Crensot Iron-works in France. *Le Genie Civil*, July 4, 1885, pp. 148 to 150.

Quay.—*See* Harbor.

Railroad.—*Railroad Building in Mexico.*—A paper read by L. Bradford before the Boston Soc. of C. E., June 17. Treats of peculiarities of construction and location not met with in the States, and refers specially to the Central R. R. Metric system used. The nature of country passed through is described and the style of work. *Journal of the Assoc. of Eng. Soc.* July, 1885, pp. 345 to 350.

Retaining Walls.—*Treatise on the Resistance of Materials in Retaining Walls.*—By M. Hétier. An exhaustive paper on the nature of the various strains, with notes as to the proper construction under varying circumstances, the manner in which they fail, and other matters. It deals with walls of various forms, with and without counterforts, and of different materials. It is replete with formulæ, and includes several drawings and diagrams. *Annales des Ponts et Chaussées.* May 1885, pp. 795 to 989.

Rolling Stock.—A comparison of the cost, earnings expenses, and other details of the rolling-stock of two important English railroads—the Midland and the North Eastern. A table is given of the mileage, expenses, etc., of the two roads, and the details of cost are fully considered. *Engineering*, July 10, 1885, pp. 25, 26.

Viaduct.—*The Mahuinot Viaduct.*—On the Montanban & Cahors Ry., in France, over the river Pax. Length 119.64 metres (654 feet) long, on a radius of 500 metres (1640 feet), and a grade of 1 in 100. Brick arches (about 30 feet span) and piers with stone facings. Illustrated. Reproduced from Annales Industrielles. *Railroad Gazette*, July 24, 1885, p. 468.

Wind.—*Wind Force and Velocity.*—A short paper on wind force as applying to ships, with notes on experiments made at different places. Tables are given compiled by various authorities, including Beaufort's table as used in the Royal Navy. *Engineering*, July 10, 1885, p.p. 28, 29.

Market Report of Engineering Materials.

New York, July 30, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	1.9c.	@	2.2c.
Tee	2.2	@	2.4c.
Beams and channels	3.0c.	@	
Tank	2.	@	2.1c
Shell	3c.	@	3¼c
Steel plates, Tank	2¾c.	@	3c.
WROUGHT-IRON PIPE., PITTSBURGH.			
Butt welded, black.....Discount	45	@	50
" galvanized..... "	35	@	40
Lap welded black..... "	65c.	@	
" Galvanized..... "	45	@	50
Boiler tubes..... "	60	@	
RAILS.			
Steel (large lots at mill).....	$27.00	@	27.50
Old rails.....	16.50	@	17.00
Old railsteel.....	16.50	@	17.00
R. R. spikes.....	1.8	@	1.9c
R. R. splice-plates.....	1.55	@	1.7
R. R. Track Bolts.....	2.55	@	2.65
Barb-wire fencing, galvanized.....	4¾c.	@	5¾c.
" " painted.....	3¾c.	@	4¾c.
Corrugated iron.....			
Nails			
Iron.....	2.25		
Steel.....	2.40		

METALS.

COPPER.			
Lake Superior.....	11.	@	11¼
Other Brands.....	10¾	@	11⅛
LEAD.			
Com. Domestic.....	4.12½	@	4.15
Lead Pipe.....	.06¾		
Tin-Lined Lead Pipe.....	.15		
Sheet Lead.....	.06¾		
ZINC.			
Sheet.....	0.05	@	0.05½

BRICK.

(Cargoes afloat)			
Haverstraw.....per M.	$6.25	@	6.50
Fishkill.....			
Up-River.....	5.50	@	6.25
Jerseys.....	5.25	@	6.00
Long Island.....			
" pale.....	3.00	@	3.50
FRONTS.			
Croton red.....	13.00	@	14.00
" dark.....	13.00	@	14.00
" brown.....	12.00	@	13.00
Philadelphia pressed.....	24.00	@	25.00
Trenton "	24.00	@	25.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	25.00	@	40.00

CEMENT.

PORTLAND.			
Gibb's English 400 lbs. per bbl...	2.75	@	2.90
K. B. & S. " " "	2.85	@	3.00
J. B. White & Bros., Portland Cement	2.65	@	3.00
do Keene's Superfine,	8.00	@	10.00
do " Coarse,	5.00	@	6.00
Roman	2.75	@	3.50
Largerdorfer German "	2.55	@	2 80
Dyckerhoff, " "	2.90	@	3.25
Stettiner " "	2.60	@	2.65
Hanover " "	2.60	@	2.65
Vorwohler, Lion "	2.90	@	3.25
Alsen, " "	2.55	@	2.60
Fieve "	2.40	@	2.50
Saylor's American	2.15	@	2.40
Windsor } U. S. C. Co.	1.00	@	1.10
Standard } U. S. C. Co.			1.15
Cable's Portland } U. S. C. Co.	2.15	@	2.40
ROSENDALE cements.....	1.00	@	1.10

LIME.

Rockland common per bbl.....	1.00		
" finishing.....	1.20		
State, common.....	.90		
" finishing.....	1.10		
Kingston, ground.....	0.95		
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90	@	95
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " " "	0.75	@	1.00
Brownstone, Portland, Ct. "	1.00	@	1.30
" Belleville, N. J. "	0.75	@	1.25
Granite, rough.....	0.60	@	1.25
Common building stone per load.	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.....	0.40	@	3.00

SLATE.

Purple roofing per square.	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.0
Choice "	55.00	@	80.
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@	.50
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2¾ × 4 to 4 × 6 in. "	.17	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30.00
Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rate "	2.10	@	2.25

PAINT.

Lead, white, American dry per lb	.04¾	@	.05
" " " in oil pure "	.05⅛	@	.05¾
English, B. B. in oil	.08¾	@	.08¾
Red, American	.05½	@	.05⅝
Litharge "	.05	@	.05¼
Venetian red, American "	.01	@	.01¼
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11½
Paris green "	.15	@	.19
Umber, Amer. raw and powdered per lb.	.01¼	@	.01½
Drop black, Amer.	.08	@	.12
" " "	.09	@	.11¾
Chrome green	.05	@	.15
Oxide zinc, American	.03¾	@	.04
" French	.06¼	@	.06½

New Railroad.—Ground has been broken for the construction of a railroad between New Oxford and York Springs, Adams country, Pa. Work was commenced on Tuesday of last week, near New Chester, with assurance from the president that it will now be pushed to completion. According to the contract, it must be completed within the next eleven months.

St. Anthony Falls.

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The commission having thus organized for business, President Loew offered a long preamble and resolution, declaring that under the law it was the duty of the commission to cause all telegraphic, telephonic, and electric light wires to be put under ground, and that the commission proposed to do the work for which it was appointed as speedily as possible. The law requires that plans and maps, with estimates of cost, shall be filed by the companies with the board within 60 days after its passage, or before Aug. 14; and if they do not do this the commission is authorized to adopt a plan of its own. It is the purpose of this board, the preamble says, to cause the wires to be placed under ground, and the secretary is instructed to notify all persons or companies owning or controlling the wires above ground, that the board will receive at the Metropolitan Hotel any plans, maps, or methods proposed for its approval; and that it requests that such plans be submitted as soon as practicable before the expiration of the 60 days prescribed in the law. The resolution was passed. The following, proposed by Mr. Hess, was also adopted:

Resolved, That the owners, lessees, or occupants of houses be requested to refuse permission for the placing of any telegraphic, telephonic, or electric wires over or on their respective buildings, without first securing a permit from this board.

Another resolution offered by Mr. Hess, requesting the companies to offer to the board at its next meeting any plans which they may have for placing new wires above ground, was passed, and the commission adjourned until Monday. In the meantime an office will be secured, and the commission will meet daily after that.

Railways in Japan.

The total length of railways now open in Japan is 240 miles, the first line opened being that between Tokio and Yokohama, which is 20 miles in length, and was opened in 1872. This line, which has five intermediate stations, cost nearly £600,000, and was constructed by English engineers. The line between Hiogo and Osaka was opened in 1874, but it has since been lengthened at both ends, and now runs from Kobe to Otsu, having a total length of more than 60 miles, and cost 7,000,000 yen. This line, which has 16 intermediate stations traverses the wealthiest provinces of the centre of Japan, and among the numerous articles which it conveys to Kobe and Osaka are silk, tea, cotton, rice, wheat, wadding, and cotton goods. It also carries inland the articles imported from abroad and the native goods sent by sea to Kobe. This line which stops short at Otsu, begins again at Nagahama, a town upon the opposite shore of Lake Biwa, and runs to the port of Tsuruga, upon the sea of Japan. The distance between the two places is 27 miles. This line was opened for trafic in 1882, so that the whole of this part of Japan can be traversed by railway, except for the break at Lake Biwa, a service of steamers plying between the two termini.

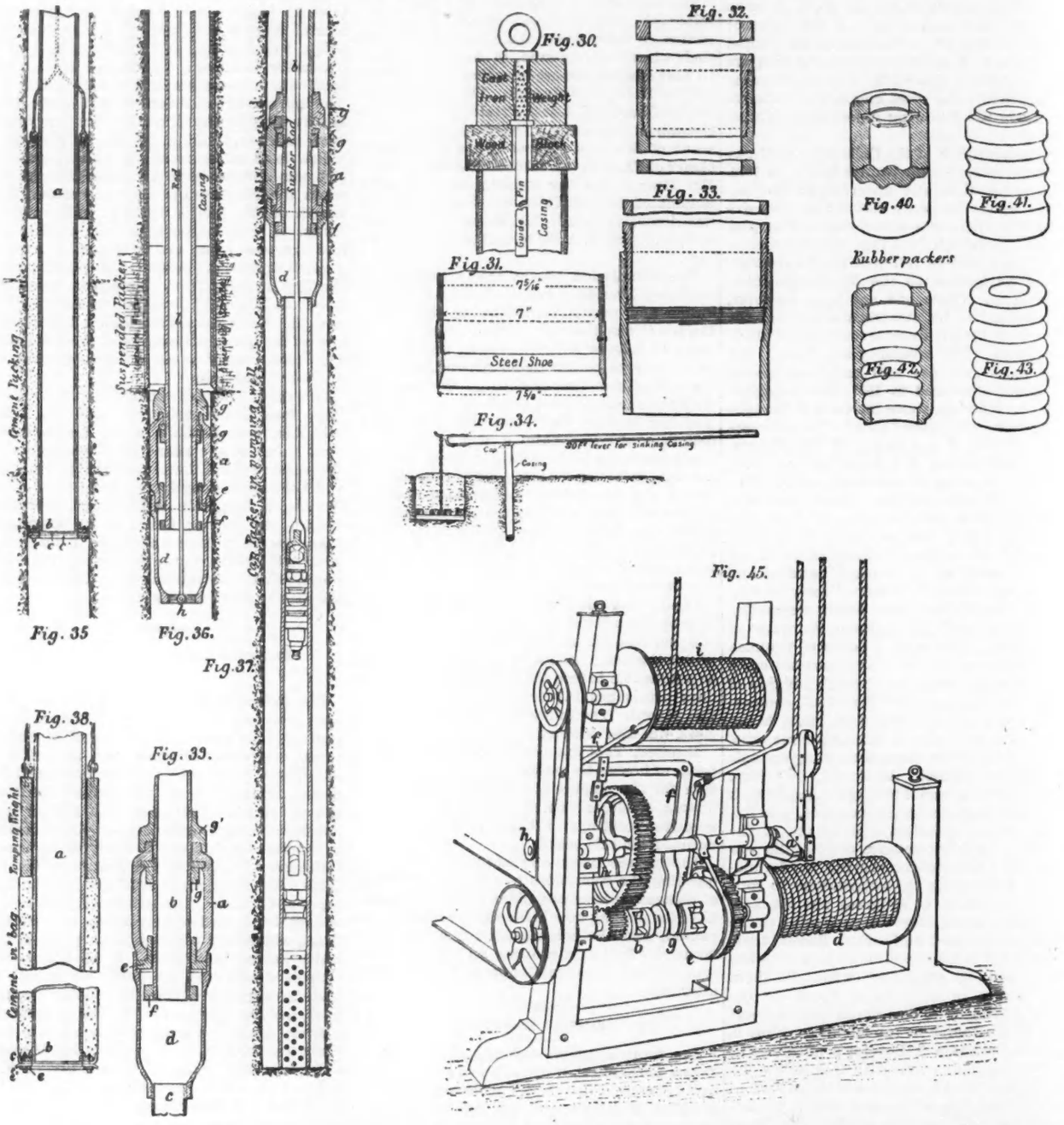
A third line has been constructed between Nagahama and Sekigahora Ohogaki, its total length being 57 miles. The terminus of Ohogaki, to which the line was extended on the 25th of May, is the centre of the province of Mino, which is one of the busiest and most productive in Japan. The fourth line open is that which connects Tokio and Takasaki. The line was not commenced until June, 1882, but by July of the following year the trains were already running as far as Kumagai, which is 38 miles from the capital, and the line was completed to Takasaki this spring, when the Emperor opened it in person. The length of this line is about 62 miles, and it brings to Tokio large quantities of, silk, tea, and tobacco from the different provinces. Two other lines are in course of construction; the first running from Shinagawa, upon the line from Tokio to Yokohama, to Kawagutchi, and the other from Takasaki to Mayebashi, one of the principal centres of the silk trade. The latter, only seven miles long will be opened this autumn.

Five other lines are about to be commenced: First, from Urawa, upon the Tokio and Takasaki line, to Aomori, a town at the northernmost point of the island of Niphon (length 450 miles); second, from Takasaki to Ohogaki and Yokkaitchi (length 200 miles); third, from Oneyda, in the province of Shinano, to Niigata (length 150 miles); fourth, from Osaka to Sakai (seven miles); and fifth, from Shizonoka to Shimidzu, in the province of Tesuruga (seven miles). A tramway from Tokio to Kofu will also be made without delay.

Proposed Drainage Regulations.

The following excellent regulations have been proposed for the city of Glasgow, Scotland: 1. The positions and sizes of all drains, pipes, cesspools, or traps, and all soil and rain-water pipes and conductors shall be shown distinctly upon the plans submitted, and the weights per foot of the lead or iron soil-pipes, conductors and cesspools be marked on the plans in figures. 2. Forty-eight hours' notice must be given to the Master of Works, at his office, previous to commencing the laying of any drains. The party giving the notice will receive a card of permission to open the street, which card will be held as proof of the notice having been given. 3. All connection between drains and the public sewer will be made by workmen of the statute labor department, and shall be paid for by the proprietor. 4. Every drain-pipe must have a uniform fall of not less than one inch to every lineal yard, and every pipe must be thoroughly packed and resting entirely on the solid earth. When the Master of Works deems it advisable, he shall require concrete foundations to be put under and around the drain pipes. 5. The joints must be well cemented and all cement projecting on the inside must be removed. 6. Sufficient traps and ventilation must be provided for, and fixed to the satisfaction of the Master of Works. 7. Before covering, all pipes must be inspected by the Master, or his representative, and no junction connecting drain-pipes and plumber-work to be covered up until examined and passed by him. 8. The Master of Works to have power to use the smoke-test on all drains and plumber-work before the building is occupied, and at any other time he may consider necessary, all expenses connected with the test to be paid by the owner of the property. 9. No dwelling shall be occupied until the Master of Works has given a certificate that the drains and cesspools with traps, have been properly constructed, and the house otherwise fit for occupation. 10. Proprietors and contractors will give every assistance to the master of works, for the purpose of performing the necessary inspection.

PLATE, 3.—APPLIANCES FOR SINKING ARTESIAN WELLS.



ARTESIAN WELLS.

Notes on Drilling and Boring Artesian Wells, as Practiced in the United States of America.

BY C. W. DARLEY, NEW SOUTH WALES.

(*Concluded from page* 50.)

The derrick is first set up true over the center of the bore, and the casing sunk, say 8 feet, as before described, to start the hole fair; then the drills may be lowered into the bore and started. From the sketch given of the gearing it will be seen that the horse-power or engine may be kept constantly going, clutches being provided for throwing either of the barrels or the Pitman sheave into gear when required. When the clutch at *b*, Fig 45, is put into gear the Pitman sheave is given an up-and-down motion, equal to twice the throw of the crank on the end of the shaft *c*. As the drills sink the rope is lowered out by applying a pinch bar or feed lever to the brake wheel *e* and bearing down on it till the pawl, in the wheel on the end of the cable drum *d*, can be released; then hold the brake and lower out as much cable as may be necessary, and when the tools reach the bottom, again throw in the pawl. The lever marked *f* is for working the clutch *g*, which travels on a feather on the driving shaft and engages the cable drum for raising the tools. The lever *h* is for tightening the belt on the pulley on the driving shaft, and enabling it to drive the barrel *i*, which carries the sand pump line; this may be a light wire rope, to the end of which is attached the sand pump. It will thus be seen that the tools can be raised rapidly by the cable drum; when they are up and landed disengage clutch *g*, drop the sand pump into the bore, easing it down if necessary by pressing on the lever *h*; and when filled again press on lever *h* and the sand pump is rapidly wound up, the engine or horse-power being kept in motion all the time. Thus a very few minutes suffice for raising the tools, clearing out the hole, and lowering the tools down to work again; and the whole operation can be attended to and manipulated by one man, a second man only being necessary for driving the engine or horses; the assistance of the second man is also necessary when it comes to building, and driving or sinking the casing.

When the hole is first started the tools may be kept short by omitting the sinker bars and jars. Should the hole be dry, water must be poured in from time to time, and when the tools stick, draw them and clear out with the sand pump. As soon as rock is met with it is necessary to add on the jars and sinker bar, otherwise the tools may stick fast in the hole; the loose action of the jars enables an upward blow to be given, by shortening in the cable and continuing to work the Pitman sheave; when an upward hammering action is imparted to the tools this seldom fails to start them up Should the tools be found to stick through the hole getting out of shape, a reamer should be used to true up the hole before proceeding with the drilling.

The description above given more particularly refers to the Gillespie Tool Company's machine, but the same will almost exactly apply to the Pierce machine. I saw both machines at work at different places, and, on the whole, would give the preference to the Gillespie apparatus, as being the more compact, but in actual work I doubt whether there is any practical difference between them; both being good and well-designed machines, and, I believe the best for the work to be found in the States.

Pennsylvanian Rig.—As I have referred to the Pennsylvanian oil rig, a brief mention of its principle may not be out of place here. This machine is specially arranged for deep sinking when bores 1,500 feet to 2,000 feet or over are necessary. In this case the tools are made up exactly as before described, but larger and much heavier; tools 4 inches in diameter and 55 feet to 60 feet long are generally used for deep 7 inch and 8 inch holes.

Over the site fixed upon for the hole is constructed a derrick, which should be not less than 70 feet high, 20 feet square at the base, and 3 feet 6 inches at head. The corner timbers of the framing may be 6 inches by 6 inches pine, or 4 inches by 4 inches hardwood, wel

braced on all four sides, horizontally and diagonally. At one side is firmly set up a Sampson post, on the head of which is placed the walking beam. Under the outer end of the walking beam is placed a Bull wheel, carrying the cable, and on its end a crank, or what was before termed the Pitman, for imparting the reciprocating motion to the walking beam. The Bull wheel is driven by belting from a steam engine, set up in a shed some 20 feet back. From the inner end of the walking beam is suspended a rod, with the temper screw attached thereto. The bore is usually started by what is termed spudding—*i. e.*, working the tools direct from the Bull wheel, lifting and dropping by slacking or surging the rope on the wheel; once they are their own depth below the surface the walking beam is brought into play. The rope is thrown off the Bull wheel, and the end caught by the temper screw; the drilling motion is then imparted to the tools, and as they sink, the temper screw is slacked out, thus lowering the tools, at the same time turning them and preventing their striking twice in the same place. The nut of the temper screw is split and held by a clamping screw, so that the leading screw can be quickly shortened in by slacking the clamping screw; at the same time a corresponding length of rope must be given out, by releasing and reclamping it in a fresh place. When the bore needs clearing out the rope is taken on to the Bull wheel, and the tools quickly run up; the sand pump, which is worked by a light line on a second reel, is lowered down and the hole cleaned out. In all operations of drilling too much care cannot be taken to insure the bit or drill being kept up to proper gauge. For this purpose it is desirable to have a duplicate of each pattern of bit used, and with the help of a portable forge, which should always accompany a drilling outfit, the spare bit can be forged to gauge and got ready for work again without delaying the drilling. The club bit, with its hollow or grooved center, is specially designed for conveniently forging to gauge.

The class of drilling has been carried on to such a vast extent through the oil regions that the men engaged in the work have become remarkably expert, so much so, indeed, that a bore 1200 feet deep can often be put down in about twenty-five days, and at a total cost of about 2000 dollars (say 400*l.*) I visited the Bradford, Pennsylvania, district early in June, 1883, and saw from local statistics that during the month of May, 226 bores had been completed, and on the 1st of June that year, 384 bores were in progress in the neighborhood.

Upon completion of the bore, and if oil had been struck, the derrick, together with the walking beam, engine, etc., is usually left in place: for although the hole may spout oil at first it will most probably cease to flow after a time, and then pumping must be resorted to. A pump barrel, with the necessary foot valves, etc., is then let down the bore and there fixed and worked by long sucker rods, the upper ends of which are attached to the walking beam, which, as before described, is set in motion by the engines and the oil thus pumped to the surface; but should the bore prove a failure and miss the oil, then the rig is usually removed, but in some parts, where timber is plentiful and cheap, it hardly pays to dismantle and remove the derrick. Throughout the oil regions the hill sides and valleys may be seen thickly dotted over with derricks in all directions close together.

Although I have described the Pennsylvanian rig at some length, I hardly think it will be necessary to introduce it into this colony for the purpose of searching for water.

Casing.—Hitherto I have referred to casing in connection with the bores, but without describing it. A few words as to the various kinds of casing, their manufacture and mode of sinking, are here necessary.

The class of casing I saw almost wholly used in California was what is termed rivetted sheet-iron casing. It is usually made from No. 14 B. W. gauge sheet iron, in 2 feet lengths, double thickness; at the bottom is a forged steel shoe (see Fig. 31), turned with a cutting edge, and bored internally for the reception of a short length (about 14 inches) of inner casing, to which it is rivetted; outside this comes a 2 feet length of the outer casing, which then stands 1 foot above the inner length. The tube is then built up of alternate lengths, each 2 feet, of inner and outer casing, thus breaking the joints 12 inches. The casings are made an accurate fit for one another, well tarred before driving together, and two or three rivets put in to secure them.

In country where saline waters are met with it is doubtful whether it would be wise to use this sheet-iron casing, there being so many surfaces exposed to corroding action that probably the iron would not last long; in most cases, therefore, it will be found cheaper in the long run to use the more expensive screwed tubes hereafter described.

The boring or drilling tools, having to work within the casing, necessarily leave a considerable amount of the surrounding soil to be cut away by the cutting edge as the casing is forced down; this is found a desirable arrangement, as it insures a close fit which cuts off surface or bad water contained in the upper measures from the pure artesian water reached at lower depths.

Should a hard vein of indurated sand, or soft rock, be passed through by the drill it may be found almost impossible to force the casing through it; in this case the side must be reamered out by an expanding reamer, such as shown on Figs. 5 and 6, thus enlarging the bore to the outside diameter of the casing.

The most usual method I found practiced of sinking casing was with a lever, as shown at Fig. 34; some planks are buried in the ground, or otherwise suitably loaded to secure the fixed end of the lever to, and then the other end of the lever which rests upon the casing is weighed down, either by the weight of the men, or by applying a purchase tackle to it. A suitable cast iron cap must be placed over the head of the casing for the lever to rest upon during the operation of sinking, to prevent its being crushed or injured.

In some ground the casing sinks very freely. I saw some sinking by its own weight when at a considerable depth (over 150 feet) below the surface; it very frequently happens, however, that the surrounding friction becomes too great to admit of the first or 7 inch casing being sunk over 200 feet: when this happens a 6 inch casing must be lowered down inside till it reaches the bottom, the boring may then proceed as before, but of course with a smaller bit; the weight of the free length of the 6 inch casing helps very materially in the sinking, it will occasionally follow the auger for as much as 70 feet below the 7 inch casing before any forcing down becomes necessary. As soon as water is reached and the boring is stopped, the 6 inch casing can be cut off about 8 feet or 10 feet above the bottom of the 7 inch casing by the tool shown at Fig. 9, or a tool somewhat similar to the reamer shown at Fig. 5 and 6, and the upper portion drawn out, taken apart, and used again in another hole; the same tool, used for lowering the casing can be used again for drawing it up.

Another method of sinking the casing is by using hydraulic pulling jacks. A suitable cast-iron head, which carries a hook at each side to attach the pulling chains to, is fixed over the pipe; two 4 or 5-ton pulling jacks are buried in the ground, one at either side, their lower ends being securely fastened to a framing, which must be previously buried in the ground some 8 feet deep round the casing, the jacks are run out full length and the long linked chains upon being drawn up tight are attached to the hooks in the casing cap; the jacks are then pumped down, drawing the casing with them: of course when steam is used this is a simple process, still it is effectively, although at a much slower rate, done by hand. This method has the advantage that one man can be pumping or forcing down the casing at the same time that the other men are carrying on the boring.

A third method of sinking casing is by driving it; this is very simply done when a drilling machine such as the Gillespie Company's is used: for by taking a bolt out of the Pitman crank a peculiar drop action is given the Pitman sheave; it is then only necessary to detach the drills from the end of the cable, hang on the driving weight, place a good block of wood over the head of the casing, with a hole through it to guide the pin, then start the machine and a series of rapid blows can be given to the casing sufficent to drive it down.

Cost of Casing.—The cost of the 7 inch rivetted casing double thickness, delivered on the ground in California, I found averaged 75 cents (say 3*s.* per foot), and the 6 inch similar casing cost 60 cents (say 2*s.* 5*d.* per foot); this is based on sheet iron costing 3*d.* per pound, = 28*s.* per hundredweight, delivered on the ground.

One great advantage in the use of rivetted casing is that the sheets can all be cut and punched true to gauge for inner and outer lengths at the factory, and a number of plates can be safely packed together and conveniently sent up the country, where a very simple curving machine can be at hand to bend them; they are then rivetted with cold rivets. There is nothing in the whole process that any handy man could not learn to do in a very short time, with the very simplest appliance.

A more permanent class of casing is made from lap-welded tubes, which can be procured in lengths up to 18 feet or 20 feet, turned and machine screwed at the ends as shown at Figs. 32 and 33. As this class of joint cannot be made on pipes less than about 5-16 inch in thickness, the cost of such casing is considerably greater than the rivetted, but it would certainly be found more durable and safer to use in sinking. The cost of such casing properly screwed, landed in Sydney, would be about 7*s.* per foot for 7 inch, and 5*s.* per foot for 6 inch, assuming it to be obtained in fair quantities. There are various ways of making the screwed joints, two of which are shown on Figs. 32 and 33. The latter is the cheaper, but that shown at Fig. 32 is the better, being the only one that secures a flush surface inside and outside the pipe, which is a most important matter.

A cheap casing is sometimes used in America, made in lengths of 14-gauge sheet iron wound spirally and rivetted along the edge. I do not think this can be recommended except in very soft ground, for it is not strong enough to stand the end crushing strain necessary to be applied when pushing it down the bore.

Stopping back Impure water.—When practicable it is desirable to use casing all the way to the bottom of the bore, but this is really only possible when the boring is through soft measures free from rock; when rock is met with the hole ought to be reamered a little, and the casing let as far as possible into it to cut off the downward flow of impure water, but should this not prove effectual to stop back the impure water some device such as that used in the oil wells for stopping the water back from the oil must be adopted. The method for doing this, which I heard was most approved of in the oil regions, where it has been applied to nearly every bore to keep the oil free from water, is by the use of what is known as a "cap packer." This is a rubber block 8 inch or 10 inch long, made almost the neat diameter of the bore, and lowered down on the end of an inner tube. In Fig. 37, *a* is the rubber block; *b* the inner tube, which of course must be carried up to the top of the bore: *c* is the lower tube resting on the bottom of the bore, which in the case of pumping wells acts as the pump barrel when fitted with a foot-valve, the upper valves being attached to the sucker rods; on the top of the lower tube *c* is screwed a funnel-shaped piece of pipe *d*, which widens out nearly to the diameter of the bore, and is turned with a seat on its upper rim to receive a ferrule *e*, which slides on pipe *b*, and acts as a seat for the rubber block; pipe *b* has a stop ring *f* screwed at its lower end to prevent the block sliding off when being lowered down, and another ring *g* at the top end to catch under a malleable iron ring fixed into the rubber block for the purpose of drawing it from the well when required; there is another collar g^1 screwed on, which fits the upper end of the rubber block and bears down on it; this also acts as a joint collar for the pipe. The action is therefore as follows: The lower end of the block rests on the head of the lower pipe, and the whole weight of the upper pipes rests upon the top edge of the block, thus compressing and expanding it against the wall of the bore, and effectively stopping the downward passage of impure water.

In the case of artesian flowing wells, the lower pipe, which is not necessary, can be dispensed with by using the same apparatus, but by inserting a crossbar *h*, Fig. 36, and attaching to it a ¾ inch rod of iron, which should be in long lengths screwed at the ends and coupled together and led up to the top of the bore; the inner pipe, carrying the packer at the bottom, must then be suspended from the surface, and the ¾ inch rod screwed hard up to bring an upward pressure against the rubber block and thus expand it.

There is another simple way to make a water-tight joint as shown at Figs. 35 and 38. This consists of an iron tube *a*, say 4 inch diameter with a flange *b*, screwed on at lower end against which are bolted two rubber rings, one *c*, about 2 inch larger in diameter than the bore, the second c^1, placed underneath a tight fit for the bore; these are nipped up against the flange with a ring washer *e*, and screw bolts. A calico bag 2 feet long and made the diameter of the bore is secured at its lower end between the flange *b* and the rubber ring *c*. This bag, which incloses an annular space round the tube, is filled with a mixture of half Portland cement and half clean sand just moistened and made into a stiff mortar; the mouth of this bag is loosely closed round the pipe, which is then pushed down the bore till the bottom reaches sound rock, at a point below the strata containing the salt or impure water, the cement may then be tamped firm home by a piece of heavy tubing, or annular cast iron weight suspended by a rope as shown on sketch. The cement will soon set hard and make a secure and tight joint.

Cost of Machines and Tools.—The cost of the Gillespie or Pierce machines, including an outfit of one rope socket, one augur stem, sinker bars and jars, two bits, two winches, sand pump and 500 feet sand line, 500 feet of drilling cable, and a horse-power, the whole suitable for drilling 500 feet deep, would be about 200*l.* delivered in Sydney, to which might be added about 30*l.* for extra fishing tools, pipe rivetters, lifters, stubs, etc., making an outfit in all cost about 230*l.*; but even this would have to be exceeded in the first instance by any one commencing to bore, as it would be necessary to provide a portable forge, some blacksmiths' tools, spare iron, etc. For going 600 feet somewhat heavier tools would be necessary, but with the same machine the cost would be about 240*l.*; by purchasing a supply of spare box and pin stubs, a great many of the special tools shown on the drawings could be made by any ordinary blacksmith and the stubs closed on.

The boring machine outfit would not cost over 80*l.* complete. Excepting the horse-power and crab winch with connecting gear and the screwed ends for the wooden and iron pipe rods, there is no part that could not be made up the country, by any carpenter and blacksmith. Most of the machines of this class which I saw at work were evidently constructed by the owners, who, in most cases, I found, had been mechanics qlacksmiths, or general hand men, well able to make all their own tools, as well as the numerous special tools that are found necessary from time to time during practical working.

In situations where many bores may have to be put down, and where water and fuel can be conveniently obtained, I would certainly recommend the use of steam instead of horse-power, for expediting the work, and thereby lessening the cost of labor. Almost any make of portable engine can be adapted for the purpose. To run a 600 foot drilling apparatus an engine of about five horse-power would be ample.

For the generality of work, however, I believe the ordinary horse-power machine will be found sufficient

though of course much slower, both horses and horse keep being cheap and always available throughout the country.

It is unnecessary here to refer to the cost of steam engines, as full information can always be obtained from any Sydney importer.

American well drilling tool catalogues quote prices for engines, but English-made engines can be landed in Sydney much cheaper.

Cost of Boring or Drilling.—As regards the cost of boring or drilling, I found nearly the one price ruled all through the country; no matter what kind of apparatus was used a set contract price seems to have become established. What the net cost was I could not well find out, but of course it would vary a little in every case, but seeing the eagerness with which contractors sought for and took orders, it is evident the contract quoted below pays well.

The rates are as follows:

ft.	ft.	ft.	s.	£	s.
0 to	100 =	100 at	2 per foot	10	0
200 "	300 =	100 "	3 "	15	0
300 "	400 =	100 "	4 "	20	0
400 "	500 =	100 "	5 "	25	0
500 "	550 =	50 "	6 "	15	0
550 "	660 =	50 "	7 "	17	10
			Cost for boring hole 600 feet deep	102	10

To this must be added cost of casing, which, as before mentioned, cost when rivetted 3s. per foot.

	£	s.
600 feet 7 inch casing, at 3s.	90	0
Add to this the cost of boarding the contractor and his two men, as I found it was the practice for the farmers whom the work was being done to keep them while at work, say, three men for six weeks = one man for 126 days at 2s.	12	12
Total cost for a 600-ft. hole	205	2

Say 6s. 10d. per lineal foot.

If a length of 6 inch casing had to be used the cost would be reduced a little. I have allowed six weeks for the boring; this is the outside time a 600 foot hole would occupy, unless some serious mishap occurred to delay the work. I have already mentioned a case where with the hydraulic boring apparatus a hole had been sunk over 500 feet in 11¾ working days. It must be borne in mind, however, that in this case a steam engine was used, and when an allowance is made for procuring water, fuel, stores, etc., the cost of the work will nearly mount up to as much as the slower horse-power machine.

Arrangement Adopted in California for Irrigating from an Artesian Well.—Upon the completion of a bore if it prove a flowing well, the casing is left standing from 4 feet to 5 feet above the surface, an area of about an acre is then inclosed to form a reservoir around the well, by raising a mound of earth, say 5 feet high; the land around is cut up into about 5-acre paddocks, termed "checks," and properly levelled off for irrigation; four main feeders, termed "ditches," are constructed from the central reservoir along the boundaries between the checks, the bottom of the ditches being kept a little above the surface of the check; very simply constructed wooden gates are placed at the opening to each ditch, by raising any one of which the water can be led along the ditch and again let out through side gates over any one of the surrounding checks needing irrigation. It will thus be seen that the storage reservoir, which holds about 1½ million gallons, is filled by the well, and emptied daily, or as the land needs it, by running the water off through the various ditches. I was informed that the farmers generally considered a good well sufficient for irrigating from 160 to 200 acres of tilled land.

I experienced great difficulty in obtaining information as to the quantity of water discharged from any of the wells; the amount of course varies considerably. Only in one or two instances could I get near the tube to measure the height the water rose over the lip of the pipe, for, as already mentioned, they invariably stood out in the center of a round reservoir some 4 feet or so deep.

I measured a few that I gained access to, and in these instances I found the water rose from 2 inches to 3 inches over the lip of the pipe, the local practice being to speak of the well as an inch, 2 inches or 3 inches flowing well, as the case might be. I only saw a few 3 inch wells, and they were considered amongst the best. I estimate the discharge from a 3 inch well would be about 550,000 gallons per twenty-four hours and from a 2 inch well, about 350 gallons for 24 hours. Of course there are cases where the artesian water rises under very heavy pressure. When such are found, pipes can be connected with the casing tube, and the water led away for supplying buildings.

A portion of the town of Honolulu, in the Sandwich Islands, is supplied from an artesian well in this way. I there saw some wells discharging under very heavy pressure. One was throwing water through a 5-inch pipe to a height of at least 25 feet into the air; but in California I did not see or hear of any such wells.

Torpedoing Wells.—The system adopted in Pennsylvania known as "torpedoing," for increasing the flow of oil wells when first bored, might perhaps be found of use in artesian wells.

When the oil-bearing strata is reached, and the boring is considered deep enough, a heavy charge of dynamite, with a fuse attached to it, is let down to the bottom of the well—or, better still, the dynamite charge may be lowered down with insulated wires attached, and when on the bottom fired by a portable battery on the surface. The explosion shatters the surrounding rock, opening the joints, and allows a free escape of the oil to the bore. Although this method is almost universially adopted in oil wells, I never heard of its being tried in a water-bore, but I think the experiment would be worth trying with a light charge in a case where water may be met with on strong ground.

Suggestions as to Importing Apparatus.—I have not had an opportunity of making myself acquainted with the nature of the apparatus that has been tried or now is being used in this colony for drilling or boring for artesian wells. I am well aware the diamond drill is being largely used for boring to test for minerals, but for the purpose of obtaining a water-supply such drills are quite useless owing to the small bore. Diamond drills can, of course, be made for all sizes up to 20 inches or 24 inches in diameter, of which latter size I have seen one, but when the ordinary small bore is exceeded, the cost increases rapidly. Should the government not have already imported any machine such as I have described in my report, I would recommend that an order be sent to either the Gillespie Tool Company or the Pierce Well Excavator Company—or, perhaps, to both—to send out a machine and complete outfit suitable for drilling 500 feet to 600 feet deep; also, that they be requested to send out an experienced man with their machine to work it here upon arrival. I am sure either of the manufacturers would for their own sake select a skilful and trustworthy man, who would soon train others here into the work. Should the department in charge once show that boring can be done expeditiously and at a reasonable expense, I am persuaded that private enterprise will not be slow in coming forward to import the appliance found most suitable, and that in a few years' time the Government will be entirely relieved of the trouble of carrying on this work except through the medium of contractors.

Piers of Ancient Bridges.

The Italian as well as the ancient architects seem to have regulated the thickness given to the piers of bridges by proportioning them to the span of the arches, without regard to any other circumstances. In the little bridge over the Ilyssus, near Athens, the middle arch of which is only 19 feet 10 inches span, the extraordinary thickness of nearly 8 feet 6 inches is given to the piers, being nearly five-twelfths of the span. In the bridge at Rimini, admired by Palladio for its beauty as well as strength, nearly the same proportion is observed. In the bridge over the Bacchilione, at Vicenza, the piers are one-sixth of the span of the middle arch; and in a design by Palladio himself he makes the pier to the middle arch one-fifth of the span. L. B. Alberti says that the piers ought not to be less than one-sixth, nor more than one-fourth of the span.—*Joseph Gwilt.*

Floating Landings.

BY LUDWIG SCHRADER.

Translated for ENGINEERING NEWS from the Transactions of the Society of the Architects and Engineers of Hannover, 1885, p. 465-468, by GEO. J. SPECHT, C. E.

Floating landings are used only where the passenger-traffic is large, and are not applicable to freight-traffic.

The purpose of floating landings is to provide sufficient landing place for the largest number of vessels, arriving or leaving simultaneously, and to furnish a sufficiently large area for the undisturbed movement of the traveling public. Large traffic requires extensive landings; they are made of a number of floating caissons, connected with each other by a common dock. As the demand increases, new caissons can be added and connected by a dock with the old landing. The interior of the caisson can be utilized as storage-rooms, privets, or dwellings of employees. Larger caissons must be divided into several water-tight compartments, so that in case of a leak the same can be separated from the other parts of the caisson. Each of these compartments must be provided with a man-hole and a pump. The side where the vessels land must be protected with heavy boards; on top of the caisson sheds and banks, for the accommodation of the public, are built, and a railing put up where the open space is not needed.

Fig. No. 1 is the plan of a floating landing, 820′ long and 8.2′ wide. The dimensions are sufficient to allow vehicles to drive up to the vessels. The larger steamers land on the side towards the harbor-entrance, while the smaller ones land on the short sides, which are 2′ lower. Four moveable bridges connect the landing with guard; their length is such, that their inclination is not more than 1 in 15 even at the time of the lowest water. The landing proper (Figs. 2 and 3) is supported by 42 floating caissons being 20′ distant from center to center. The clear space between two caissons is 6.56′. Five girders run across them lengthwise; they are fastened to the caisson in such a way that each of the latter can be detached separately, if repairs should require it. The girders are iron box-beams, and sufficiently strong to support the traffic, even if one caisson is taken out. On top of these girders are a number of wooden cross-beams, each made of two pieces, bolted together, 6.56′ apart from centre to center. They are notched into the iron girders. On top of these cross-pieces is a double layer of boards, the upper layer being made water-tight. Each of the caissons is 82′ long, 13.1′ broad and 4.92′ high; each is divided into 4 water-tight sections by 3 iron partitions. The caissons are built of strong sheet iron, strengthened and connected by iron framework. Fig. 4 shows the connection of the deck and bottom with the sides. Fig. 5 represents the joint of plates.

The total weight of the entire landing is in round figures 5,060,000 pounds; the aggregate bottom area of the 42 caissons is 45,116 square feet. This makes the immersion of the landing

$$\frac{5{,}060{,}000}{45{,}116 \times 62.5} = 1.79 \text{ ft},$$

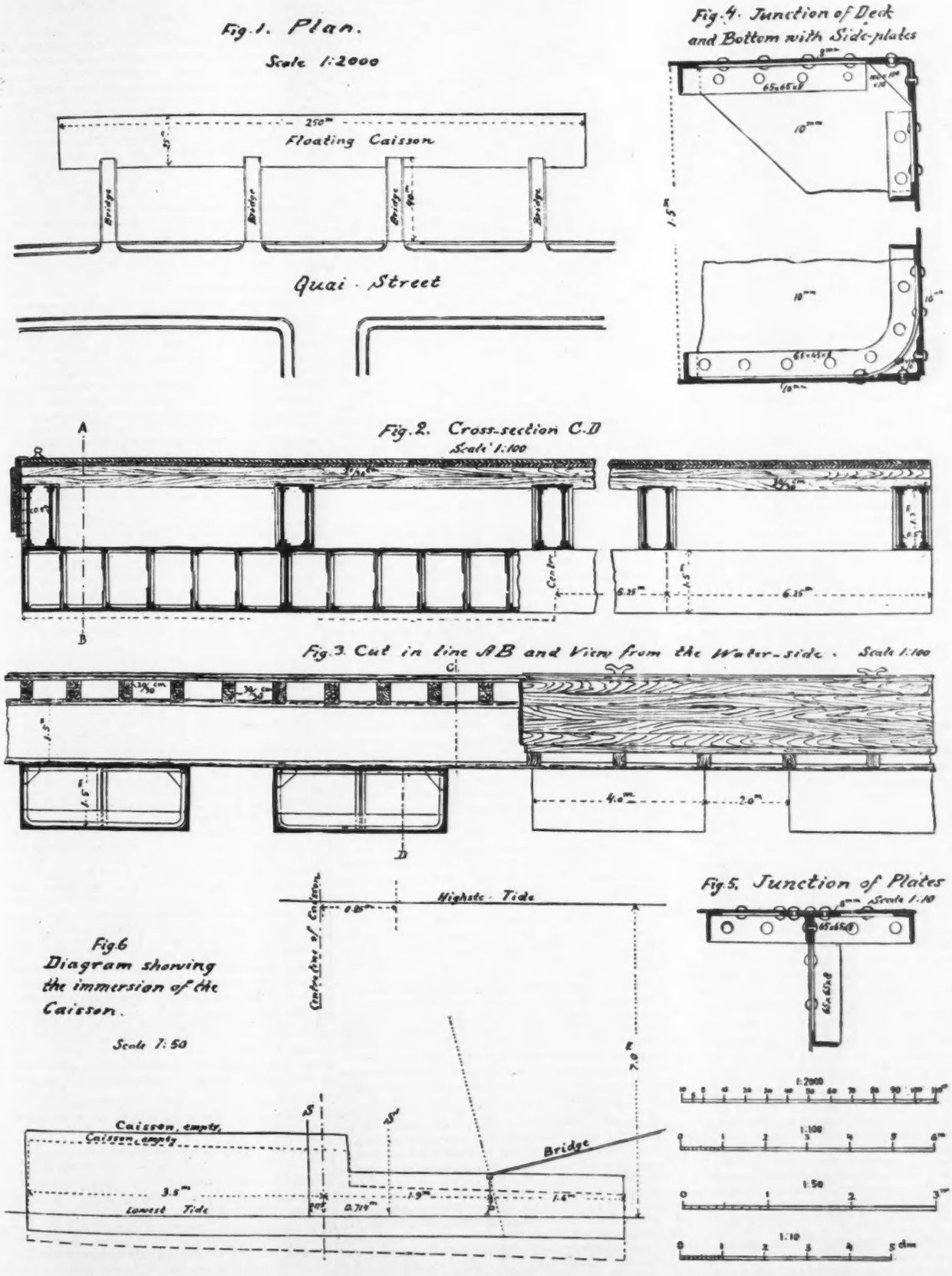
In smaller landings, used only by foot passengers, it is best to make the top-plate of the caisson of corrugated iron and put a cover of asphaltum.

EXAMPLE OF DETERMINING THE IMMERSION OF A CAISSON, FIG. 6.

Assume that the caisson (Fig. 6) is in a tidal river, and is connected with the shore by movable bridge. The difference between low and high tide is 23′. The bridge, loaded with 61 pounds to the square foot, is so located, that it reaches 5.3′ over the landside edge of the caisson at time of lowest water, and within 2.78′ of the center of the caisson at time of high water. The caisson is constructed of iron and is braced by wooden top-beams and floor-sills. The deck is covered with asphaltum; the outsides are protected by boards; the deck is 59′ long and 23′ wide. The water side of the caisson is 12.5′ wide and 3.94′ high, the landside 10.5′ wide and 2.46′ high. The bottom area of the caisson is 1357 square feet. Assuming its own weight as 66,000 pounds, the immersion will be $\frac{66{,}000}{1357 \times 62.5} = 0.77'$. The bridge is 82′ long and 13.1′ wide and weighs 33,000 pounds. The caisson carries half of this weight; this produces an additional immersion of $\frac{16{,}500}{1357 \times 62.5} = 0.19'$. If the entire caisson is loaded with a load of 61 pounds per square foot, the additional immersion caused thereby is 0.97′; the bridge being also loaded with 61 pounds per square foot, the weight transferred to the caisson is $\frac{82 \times 131 \times 61}{2} = 32{,}757$ pounds, which causes a further immersion of 0.38′. If the bridge and caisson are loaded the immersion of the caisson is 2.31′, but if not loaded is 0.96′.

It is assumed that the weight of the iron of the caisson and the weight of the asphaltum

FLOATING LANDINGS.



is equally distributed; the wooden protection of the outside as well as the weight of the bridge, destroy the equilibrium. If the bridge does not rest on the caisson, then the wooden protection, weighing 1100 pounds, moves the centre of gravity S 0.574′ toward the waterside. The immersion is then on the waterside 0.805′ and on the landside 0.725′. The greatest inclination toward the landside takes place when the caisson is unloaded and the loaded bridge rests on it at P with a weight of 49,500 pounds, and when P (during the lowest water,) is 6.24′ distant from the center. The weight then passes at a distance of 2.34′ from the center towards the landside. The outside immersion is then 1.18′ and the landside over 1.47′. If the caisson is then loaded equally with 61 pounds per square foot, an additional immersion of the caisson of 0.97′ occurs. The greatest immersion is then $1.47 + 0.97 = 2.44'$ on the landside, and $1.18 + 0.97 = 2.15'$ on the waterside. The greatest inclination of the caisson is then 75 to 1.

ENGINEERING NEWS Three months for One Dollar.

The Railway Situation in Mexico.

The following letter is written by Mr. W. W. Nevin, the Secretary of the Mexican National R. R. Co., and gives the best general exhibit of the situation we have yet seen:

On Tuesday, June 23d, there was published at the City of Mexico, in the Diario Official—Government *Gazette*—an executive decree or proclamation announcing a financial crisis in the affairs of the Republic, and presenting the outline of a plan of temporary relief. On Wednesday, June 24th, there appeared in the leading papers of the United States and Europe, by Associated Press, what purported to be an abstract of this decree. It fell like a bomb on the financial centers of the world, thanks to the electric wire, the nervous system of modern life. The decree announced a temporary suspension, on the part of the Mexican government, of all its obligations contracted within a certain limit. It was claimed, or seemed to be claimed, by high political authority in Mexico, that this suspension applied to the customs subventions granted to the American railways, as well as to other pledges of customs whose title is not so well known here. American jurists on behalf of the railways, promptly denied the validity of such claim, holding that the concessionary rights of the railways in the customs certificates could not be touched by this decree, that they were strongly intrenched in the constitutional law of Mexico itself, that they were, in fact, an executed contract between Mexico, acting by its Congress, and the companies, which could not be impaired save by the consent of both parties. So the question rests at this moment. It is believed that an official interpretation of the language of the decree will soon be obtained from the executive of the republic of Mexico.

Now let us briefly present the facts which have led up to this situation, and made it possible for an executive decree from the City of Mexico to be anxiously discussed in the capitals of the world within 24 hours, as an "Order in Council" from England or a French plébiscite might be. Ten years ago no government step in Mexico would have much interested the world, or indeed have been heard of beyond the limits of the republic, perhaps for months. To-day, through the American railways building in Mexico, Mexico has entered the family of nations, has a national character to sustain among nations, and what she does interests and concerns the civilized world. It is the story of this railway building that I wish to tell up to date, and it can best be told by presenting.

First—The railway situation in Mexico to date, that is, the work done.

Second—The subvention situation on which these railways are more or less based, and which was the invitation from Mexico for them to come.

Third—The economic situation in Mexico which has followed their coming.

All these pictures or situations will be presented in plain statements of facts, and after those facts results.

1. The railway field in Mexico. Something over twelve years ago the American railway builders in Mexico begun their work. They accented concessions from the Government, organized, raised money, but the panic of 1873 put a stop to their labors. The ground was steadily held, however, and in 1880 the work went forward. In the fall of 1880 and spring of 1881, new concessions were granted by Mexico to several American companies—notably to the National, the Central, the Southern, the Interoceanic & International, and another International popularly known as the Huntington line. Work on the National and Central was begun before the year 1880 closed. To-day the milage of American constructed railway systems in Mexico foots up as follows:

Mexican Central	1354
Mexican National	910
Huntington	120
Sonora	265
Altata to Culiacan	38
Tehuantepec (forfeited)	28
To these may be added the Yucatan lines	68

partly built with American capital. This, with perhaps 353 miles of English road and perhaps 500 miles of Mexican, mostly in short lines, constitutes the railway field in Mexico as it exists in iron on the ground. Of the National lines 161 miles are built across the south-western edge of Texas, in order to give the system a seaport vent, which it finds in the port of Corpus Christi.

Further construction is now in progress by the Central on its Tampico division; by the National on its Morelia-Patzcuaro division. Within a few months the American & Pacific, a northern transcontinental line from Eagle pass to the gulf of California, concessioned a more recent date, has begun building at Topolobampo, its western terminus. The Sonora road, running from Guaymas to Nogales, is a completed line. The Huntington road, which enters Mexico at Eagle pass, seems to have suspended progress at Monclova. No work was done under the Southern or International & Interoceanic concession, and in May of this year they were finally forfeited. Roughly, there are therefore about 2500 miles of American railway in Mexico, and the amount is steadily nereasing by new construction in actual progress. It is estimated that over $80,000,000 cash of American capital, or capital procured in Europe by American efforts, have been invested in these railways—and this estimate is a very conservative one. Every railway concession is attended with a telegraph concession for a line corresponding to the line of the railway. In the wake of the railways, there has followed down a train of smaller American enterprises—telegraph and cable companies, telephone companies, street railway companies, stock ranches, hotels electric light, newspaper, lumber, colonization, banking, manufacturing, and various other industries. It is impossible to estimate the capital invested in these auxillary enterprises, but in the aggregate it is very large. Next in the magnitude of the American railway interest of Mexico comes that of mining. The sum of capital invested in mining and reduction works is often placed at $50,000,000, but this is perhaps rather guessing than statistical work. Boston advices state that the fall in the securities of the Mexican Central road alone, consequent on the alarm created by this executive decree, represented a loss to their holders of $10,000,000. This fact significantly illustrates the magnitude of American interests in Mexico, and the quick sympathy which for the future must exist between the two countries.

2. The subsidy situation—When Mexico invited the American railway builders to her territory, she did so with earnestness and liberal promises. She could not indeed subvention the new roads as the United States had subventioned its great transcontinental lines. She had no public lands to give; no gold to give, no national credit even to lend. What she said substantially was "Silver and gold have we none, but such as we have we give unto thee." What she could give and did give were bare franchises—exemption from nationalities and local taxation; free importation of materials and the customs certificate subvention. Mexico railway subventions are of two classes.

A.—Those paid in silver.

B.—Those paid in customs certificates.

Class A are few in number, and were generally given for short lines to Mexican companies. Very few of the American lines are subventioned in silver. Further these silver concessions generally bore a clause limiting the amount to be paid in any one year to any one line to $120,000. So they could not fall very heavily on the treasury. The only exception of moment was the Sonora line of 265 miles. This line was completed in good faith, and the entire subvention of about $2,500,000 earned. Of this sum, about $1,000,000 has been paid, leaving the government still in debt to the company $1,477,654. Substantially, these silver subventions, do not enter into the consideration of the present situation. The second class, B—payable by customs certificates—comprise the body of concessions. The Huntington line received no subvention either in silver or subsidy certificates. Of the other concessions, the the National and the Central are the only ones under which anything has been built—the fractional sections at Tehuantepec and Altata being inconsiderable. It is important to bear this in mind. Loose statements are made all the time about the reckless extravagance of the Mexican government in granting away its subsidy to innumerable American railways. Let it be remembered that so far only two railways are enjoying such grants, and that the government does not in any way pay out a cent of subsidy to them until it has the roads built, and built according to the plans and specifications of its own engineers. It is true that a number of bare charters were granted to other companies, but the concessionaries being unable to make good their word the Mexican government has not paid out a dollar to them, and does not owe a dollar to them.

Now, as to the physical nature of these customs, subsidies and the mode in which they become cash. The customs certificates are government paper or scrip, which is legal tender for a fixed proportion of customs duties. The merchant buys the paper from the railway companies and pays his dues to the custom house with it. As matters now stand, the Central subsidy certificates are legal tender for 8 per cent. of all customs dues, and further, 8 per cent. of every customs duty must be paid with it. The National subsidy certificates are legal tender for 6 per cent. of all customs duties, and 6 per cent. of all duties must be paid with them. In all, the government has now, therefore pledged to American railways 14 per cent. of its customs duties of Mexico, therefore, should have been increased to an amount equal to 14 per cent. of what they were before the railway building began, these customs subventions would really have cost the government nothing, and she would have the railway free. As a matter of fact, as shown later on, the customs have increased 90 per cent., and dragged up with them the internal taxes about 50 per cent. Surely the customs subventions have not been a burden on Mexico.

To sum up briefly:

The American Railway subventions—central and national—earned up to date, are about $21,000,000, and this amount has, I believe, been delivered in certificates to the companies, or very nearly all of it. The amount collected in cash through the custom houses to date is, however, roughly but about $6,000,000. For this, Mexico has over 2000 solid miles of extremely well-built railways. In fact, the railways have been built and delivered in advance, and the companies are receiving what payment they get from Mexico in small instalments stretching through years. There does not seem to be either much government extravagance or corporate greed in this arrangement. It is true that the customs revenue has been very ruinously burdened by pledges of portions of it, but not to American railways. A report of Gen. Miguel de la Pena, secretary of the treasury, shows that on June 30, 1884, 85 to 92 per cent. of the income of the several ports was pledged. Since that date 2 per cent. more has fallen due to the Central—it was then getting only 6—making the total proportion pledged from 87 to 95 per cent. What the character or validity of these pledges are I do not always know The main objects for which the various pledges were made were loans to the Banco Nacional, the nickel fund, harbor improvements, the Carvajal bonds and municipal taxes. By an amicable arrangement had later with the Banco Nacional, the large pledges made to it were greatly reduced.

3. The economic situation that had followed the railways.—The commercial and economic stimulus given to the country was felt at once. There was seen: First, a healthy development all over the country, and second, a change to some extent of the currents of trade. To establish the first fact, I present a table showing the progress and rate of progress of Mexico since railroad building began, as measured by the increase of national revenue. They have been no very material changes in the taxes within the period cited, but perhaps there has been some increase in the efficiency of their collection, brought about by the strengthening of the arm of the government by the railways. Active railway building only began in the winter of 1880, but the looking forward to the coming of the railways, and the planning for them, and the negotiation of concessions, gave a stimulus to the country several years before actual construction took place. This table presents the total revenues of Mexico for the last six fiscal years, distributed into customs and internal taxes. These figures are compiled from the official reports of the treasury department of Mexico, and have never before been published in this country. The table should be prefaced with the remark that from 1867 to 1877 the national revenues of Mexico averaged about $16,000,000.

NATIONAL REVENUES OF MEXICO DISTRIBUTED INTO CUSTOMS AND INTERNATIONAL TAXES.

	Total revenues.	Customs.	Internal taxes.
1878-79	$17,811,125	$10,464,677	$7,346,448
1879-80	21,124,037	12,754,517	8,369 520
1880-81	23,172,723	14,462,213	8,710,510
1881-82	28,278,970	18,030,436	10,248,534
1882-83	30,689,783	19,119,726	11,570,057
1883-85	28,288,927	17,423,529	10,861,398

The railway era in Mexico has therefore brought with it a steady and symmetrical increase of the national revenues. It is to be noted that this increase is not confined to the customs, which more or less measure the development of foreign commerce, but is felt also in the internal development. Further, this advance has gone on right in the face of a period of unparalled world wide commercial prostration and depression. The slight decrease of $2,400,000 in the last year can hardly be called a decrease when the condition of the world is considered. The decrease in the total revenues in the United States for 1884 as against 1883 was $50,000,000, or one-eighth of the whole. It is certain that so slight a decrease in the revenues of Mexico could never have precipitated a financial crisis under any reasonably prudent administration of them. In this general movement forward the people of Mexico and the United States are growing closer and closer together. The table following presents the trade of Mexico (total exports and imports) with the United States, also for the last six fiscal years. This table shows commercial merchandise in one column and the total interchange—coin, bullion and merchandise—by another column. The coin and bullion, which is large, is almost entirely an import into the United States from Mexico, and the movement of coin and bullion swells more rapidly than the movement of merchandise.

	Merchandise only.	Total coin, bullion and merchandise.
1879	$12,245,465	$20,809,103
1880	15,076,086	24,195,281
1881	19.489.040	28,626,864
1882	23,944,481	30,975,000
1883	24.764.743	34,645,000
1884	21,720,778	35,072,314

The symmetrical and healthy progress of Mexico is further illustrated in the fact that for several years past the exports and imports of merchandise of France and England, combined with Mexico, have about equalled the exports and imports of merchandise between Mexico and the United States, and they keep pace in their rate of progress. These tables can be fitly supplemented by a third representing the export trade of Mexico with the world for the past three fiscal years, distributed by the several ports of export through which it leaves the republic. These figures demonstrate two marked facts: first, that Mexico has been advancing in the absolute volume of her exports even in the period of extraordinary and world-wide depression; second, that the new currents of trade brought about by the railways are settling in towards the United States. To bring out the illustrative feature of this table let me state that the ports marked are those ports

of exit and entry where the railway lines cross the American frontier, and that they are all such ports that there are at this time. Laredo is the point where the National enters the United States. Piedras Negras where the Huntington enters, El Paso del Norte, where the Central enters, Nogales, where the Sonora enters.

EXPORTS OF MEXICO WITH THE WORLD.

	1881-2.	1882-3.	1883-4.
Vera Cruz	14,909,230	23,956,316	25,119,420
Progreso	2,953,041	3,741,025	4,669,572
Mazatlan	4,480,728	4,639,896	4,529,521
*Paso del Norte	89,994	881,019	2,500,694
*Nuevo Laredo	271,916	1,219,933	1,988,694
Tampico	1,162,690	1,275,455	1,038,276
*Nogales	5,768	143,311	844,638
Tabasco	293,570	435,247	650,618
Matamoras	616,451	585,117	601,785
Isla del Carmen	554,252	613,157	553,586
Le Paz	613,825	695,929	506,893
Guaymas	413,318	375,471	478,211
Tuxpan	677,320	540,376	410,641
San Blas	268,177	439,617	305,664
Manzanillo	132,123	455,394	304,433
Coatzaoalcos	222,055	198,795	280,465
Acapulco	178,291	265,618	276,130
*Piedras Negras	115,157	109,259	254,088
Campeche	122,464	172,532	171,088
Others	912,923	1,064 228	1,180,829
Totals	29,093,293	41,807,596	46,725,496

It will be seen that, while the exports show a healthy increase at almost every point, the only port which leaped forward with immense ratios, demonstrating an actual new creation of business, are the ports where railways enter the American frontier, and all such ports do show this. The movement is so uniform as to have the character of a law. Mexico enters the world through the United States. Summing up the economic situation, the railways at this time, for a cash receipt to date, of $6,000,000, seem to have increased the revenue of Mexico over the average of the decade previous to the railway era ($16,000,000) as follows:

1878-79	$1,811,000
1879-80	5,124,000
1880-81	7,172,000
1881-82	12,378,000
1882-83	14,689,000
1883-84	12,284,000
Total	$53,358,000

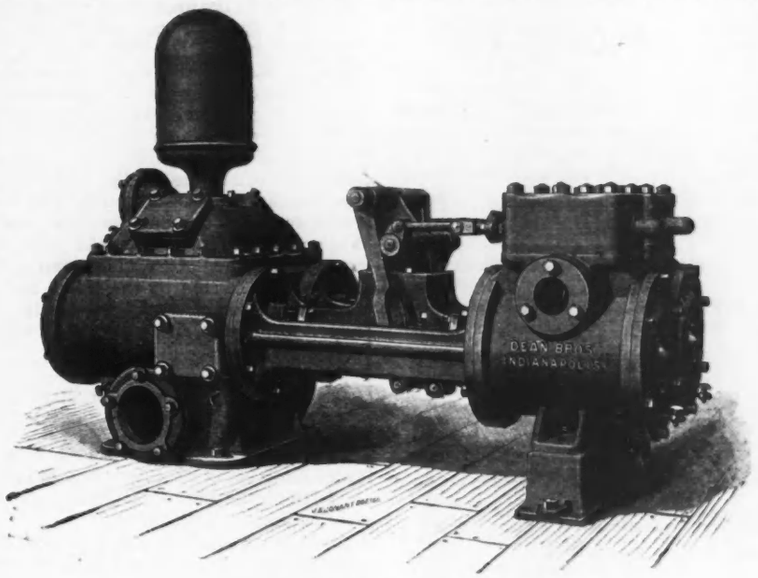
In other words the subsidies received have been just 11 per cent. of the increase of the national revenues, brought about by the railway development of the country. In conclusion, it is worthy of note that the American railway building movement in Mexico has been a spontaneous coming together of the people of the two countries. Whenever the respective governments of the two republics have touched the matter (with the exception of the granting of the concessions and the postal treaty), it has generally been to burden and embarrass intercourse. The United States government has failed to conclude the reciprocity treaty. Both governments keep up a double line of hostile custom houses along the Rio Grand. The Mexican government has recently established a special corps of fiscal police for the purpose of making additional examination of goods at interior points, a conception which reminds one of the mediæval assaults on trade and commerce. Nevertheless, the commercial union of the people will come.

W. W. NEVIN.

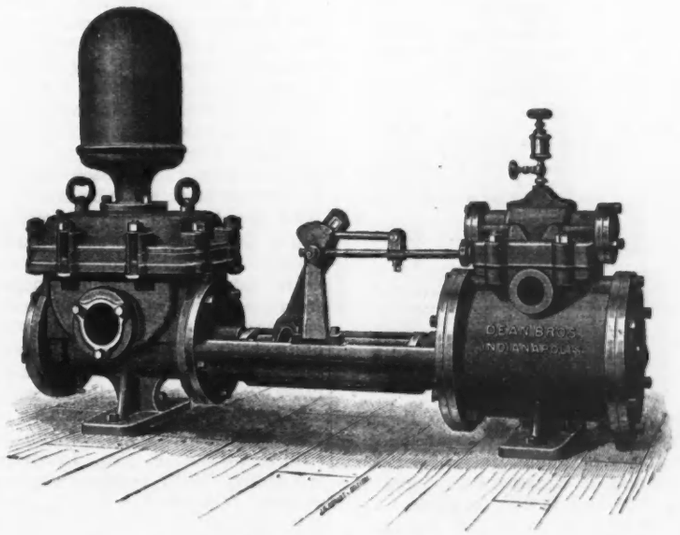
Chicago Sewers and Death-Rate.

As the cholera epidemic in 1849-50 led directly to the introduction of lake-water and the foundation of what is in some respects now the most magnificent system of water-supply in the world, so the repeated epidemics of cholera and dysentary led to the adoption in 1856 of a system of sewerage which within twenty-four years thereafter had furnished more linear feet of sewers per capita of population, than any other of the large cities of the Union. For fourteen years (1843-56 inclusive) the average annual death-rate of the city had been 37.91 per thousand, probably the highest of any city in the United States; during the first fifteen years of sewer construction (1856-1870) the average annual death-rate was reduced to 23.97 per thousand, while from 1872 to 1884 inclusive the Average has still further fallen to 21.40 per thousand. And although there have been marked fluctuations from year to year—rising to 32.22 in 1866, and falling to 16.49 in 1878—on the whole there is a striking correlation between the annual death-rate and the number of feet of sewers per capita year by year, independent of all other influences.—*Science*, (sanitary number).

AN order has been adopted authorizing the city treasurer of Lynn, Mass., to issue bonds of the city to the amount of $25,000 at 4 per cent. per annum, not to exceed twenty years, to be used in the purchase of water pipes.



THE DEAN BRO'S DUPLEX PUMP.



THE DEAN BRO'S DIRECT-ACTING PUMP.

New Pump Designs.

The duplex-pump and its valve motion are familiar to most mechanics. Two direct-acting pumps are placed side by side and so conected that the valve motion of each is moved by its companion, The duplex steam pump here shown is intended for fire protection or water supply. As will be seen from the cut the outline is graceful and the parts heavy.

The single direct-acting pump, also for fire protection or water supply, is from new patterns. The steam valve mechanism is a recent invention. This valve gear is noiseless, even when working at a high speed.

These pumps are manufactured by Dean Brothers, Indianapolis, Ind. (ADV).

Cubic Space of Air in Stables.

Authorities on ventilation observe that a man makes twenty inspirations of air every minute, each inspiration being of a volume equal to 40 cubic inches, so that he requires 800 cubic inches per minute of fresh air to supply him with the necessary health-giving pabulum for his lungs. Each expiration unfits for breathing twice the bulk of fresh air, that is the 800 cubic inches expired per minute contaminates 1,600 cubic inches of fresh air, or nearly a cubic foot. Hence, in round numbers, a man requires a cubic foot of fresh air per minute or 60 cubic feet per hour. Thus, to give this amount of air space in an apartment it requires a room of 600 cubic feet per individual. A horse or cow is said to have six times the breathing capacity of a man, so that it will require 360 cubic feet per hour, or 3,600 cubical feet of space. If every animal requires 1,000 cubic feet per hour, it follows that the dimensions of a stable with stalls 6 feet 6 inches wide, 9 feet long, with a passage behind of 6 feet, and having a height of 10 feet, will afford this amount of space to each horse. The mode of ventilating a stable has long been a vexed question, though there is a very simple means at the disposal of the builder. The open roof is acknowledged on all hands as the most desirable; it admits of a ridge louvre or ventilator extending the whole length of roof. The ridge ventilation system was strongly recommended by the Commissioners on barrack and hospital improvements, who specially reported on cavalry stables. They also recommended air bricks, 9 inches by 9 inches, introduced in the walls along the eaves with their apertures arranged that the currents of air will flow in the direction of the ridge. A window to each stall on the swing principle, and with a series of inlets below, about 6 inches above the floor, one to each stall, give all that is required to produce a healthful stable.

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Permanent Exhibition of American Products at Rome.

We have received from Adolpho Passano, the General Director, a circular announcing the inauguration at Rome, Italy, of a Permanent Exhibition of American products; the exhibition to be opened on November 1, 1885, under the auspices of the Italian Ministry of Agriculture, Industry and Commerce and the Consul-General of the United States in Italy.

The expressed purpose of this project is the advancement of commercial intercourse between the two nations, and the encouragement of direct importations from the United States into Italy. The managers have secured recognition from the Italian Government and the use of 41 royal establishments in various parts of Italy for the display of duplicate exhibits.

The charge for space is $15 per square metre of floor space, and for every additional square metre $10; this charge is good for one year from Nov. 1, 1885. Every six months medals and diplomas will be awarded to meritorious exhibits.

All applications for space should be addressed to Adolpho Passano, General Director of the Permanent Exhibition, Rome, Italy. G. Ricotti & Co., of Rome, are the bankers of the Exhibition.

The Rifle vs. the Bow.

The London *Spectator*, in a late issue, points out the fact that the great modern advance in the construction of the weapons of war has rather diminished than increased the rate of slaughter on the battlefield. There is a change in drill and tactics, but the execution done by the breech-loader is far surpassed by the murderous work of the ancient bow. After the battle of Crecy, the French dead were officially counted by the heralds on the field, and they reported the number as exceeding 30,000. Froissart says this was mainly the work of 5,200 archers. On the other hand, in the late battle of Batoche with the rebel half-breeds of Riel, 19,000 rounds were fired, besides the work of Gatling guns, and yet there were only thirty killed and wounded among the half-breeds.

One reason for this discrepancy between the effective work of the soldier of the past and the present is, that the archer was not confused by smoke or noise; he drew near to his foe, and was compelled to take some kind of an aim, as he had to draw his arrow to his ear. The user of the rifle, on the other hand, fires through a cloud of smoke, generally without any definite aim, and as a result wastes his ammunition.

Report of Department of City Works, Brooklyn.

We have received from Robert Van Buren, Chief Engineer of the City Works of Brooklyn, N. Y., the last report of his department for the year ending February 1, 1885.

According to this document the total receipts from all sources for the year 1884 were $1,669,554,211, being an increase of $310,268 over the previous year. The bulk of the receipts, or $1,104,121, was derived from water rates.

Chief Engineer Van Buren reports as follows, on the condition of the city works: The specifications and plans for a new pumping engine at Mount Prospect Hill are prepared, and bids will soon be received for the same; a beam engine, similar to the one now working, is recommended. The fourth engine erected at the Ridgewood Works has been formally accepted, and the duty test, made by Mr. Chas. W. Copeland, is submitted with the remark that the engines are doing better work now than when tested.

The total daily pumping supply of water from the various work is put down as 39,600,000 gallons; to this is to be added 10,000,000 gallons daily obtained from the driven wells at Clear Stream and Forest Stream, making a total of 49,000,000 gallons from all sources.

The average daily consumption of water for 1884 was 38,879,034 gallons, an increase of 2,736,477 gallons over 1883. In September, 1884, the average daily demand reached 42,670,826 gallons. The average yearly increase in the daily consumption the past ten years was about 1,500,000 gallons, while the aggregate increase in 1884 over 1873 was over 2,500,000 gallons This gain is due to increase of population, and to the greater head afforded since the new 30-inch main was put in use. Chief Van Buren then states that it will not be safe to estimate future yearly increase in consumption at less than 2,000,000 gallons per day. The present consumption per capita in Brooklyn is 61 gallons, being less than Chicago with 131 gallons, Boston 105, New York 88, Philadelphia 80, Baltimore 80, Cincinnati 77, and St. Louis with 77 gallons per head.

Estimating the increase of population in the next ten years as giving 800,000 in 1895, and a per capita supply of 80 gallons as desirable, the Chief Engineer believes that a daily supply of 70,000,000 gallons would not be a high estimate, and that immediate steps to this end should be taken. By the extension eastward towards Massepequa Pond, a gravity supply of probably 20,000,000 gallons daily could be secured from the flow of streams and storage in ponds. The plans for this extension are well advanced, and the work can be contracted for by the time the water rights, etc., are secured. From four to five years, however, would be required to bring the present works up to the 70,000,000 standard, and as delay may occur, it is important that the extension be started immediately. The details of this Massepequa project were given in the last annual report.

The question of replacing the cobblestone pavement with granite block is urged, and an estimate for proposed repairing, amounting to $365,200, is submitted.

The better drainage of Brooklyn is only next in importance to the water supply. Julius W. Adams, and the late Moses Lane, in planing the sewerage of that city, twenty years ago, foresaw the necessity of intercepting sewers to carry off excessive rainfalls during storms, and the present Chief Engineer has urged their construction for many years. The existing system of sewers is totally inadequate to meet the demands upon it, as with over 300 miles of paved streets, nearly all the rainfall runs into these sewers. The late Board of Experts consisting of Messrs. Fteley and Worthen, in conjunction with the Chief Engineer, has again examined the whole subject, and they again recommend the Green avenue plan of interception, by which 2,000 acres of low land along Flushing avenue can be drained. The improvement recommended by this board was estimated to cost $1,500,000; bids were received for the work, but owing to a constitutional amendment hurried through the last legislation, and the risk thereby incurred of paying heavy property damages from floods, the proposed work was abandoned.

Report of the Chicago Department of Public Works.

Samuel G. Artingstall, City Engineer of Chicago, reports as follows on the working of his department for the year ending Dec. 31, 1884:

The daily average water supply for 1884 was 80,017,990 gallons, $9\frac{53}{100}$ per cent., of an increase over the supply for 1883. During August the quantity pumped was in excess of 87½ millions of gallons. The daily per capita consumption is placed at 114 gallons. The present distribution system consists of 543¾ miles of water pipe, from 4 to 36 inches diameter; 4,616 fire hydrants; 92,133 service taps; 2,685 water-meters and 445 water motors.

In the sewerage system there are now 414 miles of sewers from 12 inches to 9 feet diameter. Of paved streets, the city has 223.95 miles; and of sidewalks, 804 miles.

The receipts from the water-works for 1884 were $1,288,941, and the expenditure on account of the same was $1,152,094. The revenue derived from metered water and from water motors, in 1884, was $408,065.89. The total cost of the entire water-works system to Dec. 31, 1884, was $10,099,658.

The Commissioner of Public Works reports that while the water supply for last year was ample and excellent in quality, the enormous daily consumption has nearly exhausted the combined capacity of the two lake tunnels; a new and independent inlet from the lake and a new pumping station is recommended to insure an ample and reliable water supply. The same official, however, in commenting on the per capita consumption of 114 gallons, states that quite one-half of this quantity is wasted; he proves this by showing that while only one-sixth of the city's supply is measured by meter, the remaining five-sixths yields a revenue equivalent to only 3¼ cents per thousand gallons; the minimum meter rate is 8 cents per thousand gallons.

In rererring to the private improvement of Chicago the Commissioner says that in 1884, 4,169 buildings were erected at an estimated expenditure of $25,862,000 and with an aggregate frontage of 98,782 lineal feet, or over 18½ miles. In the years 1882, 1883, and 1884, nearly 50 miles of new buildings were erected at a cost of over $67,000,000.

The U. S. coast and geodetic survey has this summer two parties at work in Pennsylvania. One party, under the charge of Prof. MANSFIELD MERRIMAN, is continuing the primary triangulation over the anthracite coal fields, while the other, under CAPT. O. H. TITTMAN, is carrying the reconnoissance northward to connect with the triangulation in central New York.

Forcite Powder.

Among the explosives now in the American market is Forcite Powder, which is rapidly winning a name for itself among the older powders, and is battling for popular recognition in its claims for a front rank in efficiency and economy.

This new powder is very similar to explosive gelatine, the most powerful agent known among the explosives; it was invented by K. J. Sundstrom, a Swede, and patented in this country in 1881. It is a pasty or plastic gelatinized nitro-glycerine compound, and is composed of cellulose and nitre and nitro-glycerine.

It's advantages as an explosive are stated as follows: It is five times *less* sensitive to shock than dynamite, and is that much safer; its semi-solid state permits it to be used with ease under any and all conditions; like explosive gelatine it is impervious to water, and is thus valuable for military, naval and submarine work; it is claimed to be, on the basis of volume, 25 to 50 per cent. stronger than dynamite, and its cost of manufacture is about the same as dynamite.

In support of these claims for the new powder we notice that Gen. Henry L. Abbott, in an official report upon the test of this powder says, that taking Dynamite No. 1. as a standard and giving it a value of 100, the Forcite, with 95 per cent. equals an intensity of 133; with 75 per cent. it equals 124, and with 40 per cent. strength, it equals an intensity of 95. In a personal letter to the manufacturers of the Forcite, published with the report, Gen. Abbott, also says, "your explosive is the strongest to be had in our market, and must therefore be a prominent candidate for adoption in our Torpedo service in place of Dynamite No. 1."

The Panama Canal.

Reports from France state that the directors of the Panama Canal have asked the French Government to sanction a new issue of bonds amounting to 500,000,000 francs. The approval of the government is necessary, it seems, before the company can issue further bonds, but the French premier is reported to have opposed the demand.

In this connection the *Financial News*, of London, makes the following statement of its views regarding the history and future prospects of the Panama Canal: The Interoceanic Canal Company, organized Jan. 31, 1881, was to cut a canal from sea to sea by 1888, and it was to cost in round numbers $120,000,000. From the last official statement of the company, to date of June, 1883, the balance-sheet shows stocks and bonds sold to the amount of $51,375,000; adding $1,000,000 of shares issued for concessions, and $3,125,000 rebate on bonds, the total liability incurred was $55,500,000. The cash due and on hand was $11,600,000, which deducted from the above gives the total expenditure in the 2½ years as $43,900,000, over one-third of the estimated cost of the canal.

But comparatively very little of this amount has been expended upon the canal proper. The report shows that "preliminary expenses" absorbed $4,520,000, and a mysterous item of *Comite Americain* takes $2,400,000 more. The Panama Railroad cost $13,775,000; machinery, tools, buildings and salaries are set down in the report at $3,960.000, and the entire expense account, to June 1883, is figured at $43,900,000. The *News* puts the total amount of excavation at from 125,000,000 to 150,000,000 cubic metres, and of this amount "1,103,703 cubic metres, or less than one per cent. if the total has been dug out, although over a third of the original estimate has been expended."

The *Financial News* puts the probable present position of the company as follows: Since the report of June, 1883, and up to September, 1884, a cash sum of $111,375,000 has been raised representing obligations for $153,238,700. In last September, M. de Lesseps reported that the cash balance in the company's hands was $17,100,000, a goodly portion of which must have been spent since then. The expenditure to June 1, 1885, is estimated at $104,033,000, and the work done for this on May 15, 1885, in excavation, was 12,376,500 cubic metres.

At the rate of progress given for the early part of this year, the *News* estimates 14 years more for the completion of the work at a further cost of $140,000,000. It adds to this the cost of improvement at Panama and Aspinwall, and on the Chagres, the interest account and the expenses of administration, and makes a total of $240,950,000; or, providing for rebate on bonds, a liability of $379,025,000 in addition to the present indebtedness. At this rate of figuring, and adding what it calls "a fair allowance for banking and contingent expenses," the *News* puts the round cost of the enterprise at $600,000,000, of which the canal itself will consume $450,000,000.

With 5,000,000 tons as the yearly business and a tonnage tax of $3, the annual revenue would be $15,000,000; while the annual interest charge alone would be $24,750,000 and the running expenses $2,000,000 more.

We give the above figures on the authority of our London contemporary; but if they are only half true the outlook for the future of the Panama Canal looks dark indeed. Among the work yet to be done is the rectification of the Chagres River; and estimates of the probable cost of this work, or the possible damage it may do by breaking its bounds, are among the very doubtful quantities; we have not yet even heard of any definite plans or figures for this key to the whole situation.

Railroad Building in Mexico.

Mr. Laurence Bradford, of the Boston Society of Engineers, publishes in the July number of the Journal of the Association of Engineering Societies, an interesting paper on Railroad Building in Mexico. The following abstract is made of it:

Mr. Bradford considers only the peculiarities of construction and location in Mexico, with special reference to the Mexican Central R. R. While the greater part of Mexico is a table land, the surface of the country is not even comparatively level; it is a continual succession of ups and downs with a nearly average level. Ranges of hills and mountains cut across the plateau and make a location practically as expensive as in our own country; choppy grades and sharp curves are required. The country is open and nearly devoid of timber, a feature that lessens the expense of construction but makes ties and fuel scarce and dear.

The material excavated is mostly *tepetate*, a volcanic substance lying beneath the soil and varying in hardness from something like soft rock to clay. Rock proper is quite plentiful in parts of the country traversed. Streams are devoid of water in the dry season, but become torrents in the wet season from May to November; the rainfall is only about 26 inches, and water lies not far below the surface. Shallow wells supply water for irrigation, and in the beds of streams water is usually found a foot or so below the surface.

In working thorough-cuts, the *tepetate* when first cut down will stand perpendicular for quite a time, and the question of proper slope for cuts is still a mooted question. When dry this stuff will probably stand perpendicular forever, but when wet it assumes the consistency of clay and becomes smooth and slippery. There was little haul in the construction; it was mostly waste and borrow. The chief cause for this being that the material was transported by hand in bags and baskets by the natives.

The streams have often scarcely a beginning or an end; heading in the ridges they pour quickly down into the plains and are lost in the dry soil of the plateau. To use an Irish bull, the beds of streams are frequently higher than their adjacent banks; the explanation of this is, that the banks have been raised from time to time by the Mexican planters for irrigation purposes, and the beds thus gradually raised above the original soil. Mr. Bradford illustrates this peculiarity by a profile crossing of the Large Sauceda, where a stream and a bridge of 3 spans of 9 metres each, is located on the summit of the line and makes an expensive embankment necessary; the bed and banks of the stream form the highest ground on that portion of the line.

Stone-work construction is one of the strong points of a Mexican mechanic, who excels in accuracy of eye and general good taste. Having no frost to contend with, they often cover the face and arch of the culvert with stucco. The lime of Mexico is excellent and has some hydraulic properties. There are no stone bridges on the railroads, but very handsome ones on the highways.

In referring to the metric system in use on the railroads, Mr. Bradford refers to a series of articles written by him on this subject in ENGINEERING NEWS. The trouble in Mexico with the metric system was because of faults inherent in itself, and not because the metre did not represent a foot. The Mexican national units and those prescribed for the railways were different at that time. In dealing with Mexicans he had ordinarily to use the *vara*, equal to about 32 inches, and for long distances the league of about 2.65 miles. The engineers on the railroad however used the metre for everything; they guessed, paced and thought in metres with a few exceptions.

In treating further of the objections to the metre, which Mr. Bradford does not believe possible to remove, he speaks as follows of the Mexican practice in detail:

The *chain*—which represents a station on railroad work, the main large unit for survey and construction, and to be preserved after the road is completed, that the original location may be reproduced and old land lines and boundaries retraced if required—was 25 metres long. A more awkward division could not well have been chosen, though its total length made a convenient distance between stations. But it can readily be seen that 25 distinct units, and these units each divided in some chains into four parts and others five, made as inconvenient a measure as could well be devised for the purpose where a purely decimal division was so much to be desired. The chain should have a length, abstractly considered that will best fulfill the conditions of a large unit for the road, on tangents, curves, and in construction; that which is best for open country and timber, and in all other ways, considering everything.

Upon the proper choice of this distance much of the expense and efficiency of superintendence depends, not to mention convenience. This chain should be divided up into one hundred small units. That a hundred feet exactly fulfills these conditions, I do not pretend to maintain, but I do say that its length comes somewhere near to doing it. All would probably agree that one hundred and thirty feet, abstractly considered, would be too long, and sixty feet, considered in the same way, too short. The small unit should be of such length that it will make an easy fold for the chain, and a division that will sufficiently sub-divide the curvature on sharp curves.

Could a chain be formed of 100 metres, the conditions would be mostly fulfilled, or of 10 metres; but one would undoubtedly be considered too long and the other too short. It has been proposed by some one advocating the metric system for railroad work, to get over this blemish in a way that brings to mind the old adage, that a person can most quickly show his crude ideas on a subject by the kind of questions that he asks I would add, and by the suggestions that he makes. The way is this: The chain being 20 metres in length, that only every other one should be numbered; that is, instead of having the chains count stations one, two, three, etc., two chains should count station one; four chains, station two, etc. In leveling operations, an advantage which the metre appears to have over the foot, is that the rod is only divided in four main units—a division that seems to lessen the liability to error over having twelve main units. It is also an undoubted advantage in the calculation of earth-work to have the unit represent a side of the cubic measure used; but

these benefits I think are overbalanced by an increase of work in ordinary leveling.

I have taken for an example a gradual slope of ground from the backsight to the foresight, an operation with some variations that would be repeated an almost countless number of times. These foresights have been worked up into elevations for both feet and metres, from which I calculate that about 19 per cent. is saved in figuring when using the feet measures; and it comes about by considering the tenth of a foot as sufficiently exact for ground heights, while the decimetre would hardly be sufficiently close if assumed in the same way.

For other purposes, where it is considered convenient or necessary, we have as good a measure in the

In Feet. 1580.32 Ht. of Ins.			In Metres. 471.681 Ht. of Ins.		
B. S. 0.35	0.3	1580.0	B. S. 1.05	0.09	471.59
	1.4	78.9		0.42	71.26
	2.6	77.7		0.79	70.89
	3.7	76.6		1.12	70.56
	4.5	75.8		1.37	70.31
	5.8	74.5		1.77	69.91
	6.2	74.1		1.89	69.79
	7.1	73.2		2.16	69.52
	8.8	71.5		2.68	69.00
	9.9	70.4		3.02	68.66
	10.4	69.9		3.17	68.51
	11.3	69.0		3.44	67.24
	12.2	68.1		3.72	67.96
T. P.	12.23	1568.09	T. P.	3.727	467.954

yard as the metre—an easy multiple of the foot; and the fact that engineers who are also architects readily adopt the decimal measure in the foot and tenth for their engineering, and the duodecimal in feet and inches for their architectural work, with the yard as common to either, proves their willingness to avail themselves of what is desirable in both.

Hardening Plaster.

The *Journal du Ceramiste et du Chaufournier* describes a new method of hardening Plaster of Paris; from it the following extract is made:—

In 1878 and 1880 M. J. B. Mallion, of Lyons, made a number of experiments in the hardening of plaster from Peidmont. He first tried a mixture of plaster and fat lime; but the result was unsatisfactory, the object remaining granular and of a dubious color. He then experimented with the magnesites simply made caustic; his success was complete, the magnesia hardened the plaster better than lime, and the product was a pure white in color.

He used two methods. In the first he calcined the magnesites sufficiently to release the carbonic acid and then reduced this caustic magnesite to an impalpable powder; then mixed it in the proportions of 15 to 30 per cent. with the plaster and tempered it with water; worked it up, and when the object thus made was dry, he poured over it a solution containing from 20 to 30 per cent. of sulphate of zinc (if the objects are small they are steeped about an hour in the solution), they are then dried and polished and the product is found perfectly hard.

In the second method, when the solution fails to penetrate properly into the object, M. Mallion tempers his mixture of plaster and magnesia directly with the sulphate of zinc solution, a little less concentrated than before, and then at once uses it for the purpose intended, The resulting mass is homogeneous, handsome to the eye, has an astonishing resistance against crushing, and only an iron point will make an impression upon its surface.

The zinc solution is used on all objects that it is desirable to have remain white; in this manner are made fine statuary, mouldings of extraordinary beauty, blocks for statuary, fire places, columns and ornaments of all kinds. By lining the interior of the moulds with plates of zinc, or better still with glass, the product will have the polish of marble. The richest marbles can be likewise imitated by simply tinting certain portions of the mixture of plaster and magnesia and disposing them with judgement and art. For floors, it is better to replace the sulphate of zinc by a solution of iron, which will give to the compound a very beautiful color simular to pinewood, and this can be rendered still more pronounced by rubbing it with linseed oil.

To obtain the best results with this process two things are requisite; the magnesia must be free from silica and it must be calcined very regularly. For the latter purpose a gas-furnace, of the Siemens or Schwandorp type, is the best.

The best of the magnesites for this purpose are undoubtedly those from the Grecian Archipelago, at Afrati, Mandoudi, Lesbos or Corinth; it is sold for 27 francs per ton on the ground. The average analysis is as follows:—

	Afrati.	*Maudoudi.*
Carbonate of Magnesia	94.50	97.53
Lime	4.15	0.75
Silica	0.75	0.15
Water	0.60	1.49
Alumina & Oxide of iron	0	0.08

The magnesia of Germany is irregular in composition and too high in price. The Italian mineral is valueless on account of the great quantity of silica contained in it. The analyses from the principal sources of supply are as follows:—

	Baldusiro.	*Casalette.*	*Island of Elbe.*
Carbonate of Magnesia	80.75	86.30	84.49
Silica	18.50	13.25	12.85
Peroxide of iron, alumina, lime,	0.75	0.45	2.80

These minerals are sold at from 20 to 30 francs per ton for the first two, and 33 francs per ton for the Elbe magnesia.

Contract Prices in France.

The *Revue Générale des Chemins de Fer* for May, 1885, gives the following detail of construction of the Farges Viaduct near Meymac, France:

The viaduct has eleven arches of 49.2 feet span; its length is 679 feet, and its maximum height is 116.27 feet. The viaduct is located on a curve of 1312 feet radius.

The plinth, coping and the moulded parts of the parapet are in fine cut granite; the balustrade of lava, and the general face of the work in pitched ashlar. The total amount of masonry was 15,125 cubic yards; the price per square yard in elevation was $11.32; per square yard in plan, $59.37, and per lineal foot of viaduct, $102.50. The average price per cubic yard of masonry was $4.53.

The item prices for various portions of the work were as follows:

Excavation,	per cubic yard		$0.30 1/5
Refilling	"	"	0.05 7/9
Ordinary foundation masonry	"	"	3.23
Backing masonry	"	"	3 38 1/5
Pitched ashlar	"	"	5.07 1/9
Fine-cut granite	"	"	12.30 7/9
Balustrade,	per lin. foot		2.44
Beton, with sand	" cubic yard		1.85
Dry stone drain	" "	"	0.50
Cement sheeting 2 in. thick	" sq.	"	0.30
Asphalte	" "	"	0.83
Wood for centers, first use	M. B. M		33.03
" " " second	" " "		14.15
Iron bolts in centers, per pound			0.03 4/9
Cast-iron work	"	"	0.04 4/9

The total cost of the Farges Viaduct, including all expenses of superintendence, etc., was 348,000 francs, or say, $69,600.

The "Volapuk," or a Universal Commercial Language.

M. Schleyer, a linguistic German of Constance, has, after twenty years hard labor, solved to his own satisfaction at least the difficult problem of creating a new language that is intended for common use among nations in all their commercial transactions; he calls it the "Volapük," or universal language.

He claims that he has studied certain characteristic features of the different idioms of Europe and has combined them into a harmonious and very simple whole. His root words are taken from all the languages of Europe, but principally from the latin and teutonic types, and among the last the English has been put under especial contribution.

Le Genié Civil says that although the first publications of M. Schleyer only date from 1881, the users of the Volapük already number thousands in the States of Europe; 53 societies are now in existence whose end is to push this new tongue; they are found in "Germany, Austria, Holland, Sweden, England and even in the United States and Syria."

M. Schleyer has published a grammer and a Volapük-German dictionary containing about 13,000 words; both works are now in their 4th edition. Abridged editions of the Grammer have been published in Latin and in all the tongues of Europe, and also in the Chinese and in the Hottentot dialect. Dictionaries are being prepared for use in France, England, Italy, Holland and Hungary, and will soon appear. Two magazines are also published in Volapük; one, the *Volapukabled*, is issued with a translation, the other, the *Volapuklubs*, is entirely in the new tongue.

Cocoanut Cellulose as a Backing for Armor Plate.

A French commission at Toulon have been lately testing the efficiency of a proposed protection against the sinking of war-vessels; it is made of cocoanut fibre. There is claimed for it the remarkable property of closing up after it is pierced by shot or torpedo and thus preventing the influx of water into the ship. The published account of the trial is given as follows:

The commission submitted the composition to a three-fold test—against shot, shell and torpedo. The target was a cofferdam made of a mixture of 14 parts of pulverized cellulose and one part of cellulose in fibre. This composition was compressed to a felt-like mass, of which one cubic meter weighed 120 kilogrammes, or one cubic foot about 8 pounds. A layer of beams 12 centimeters (4¾) inches(thick represented the side of the ship, behind which there was a layer of cofferdam 60 centimeters (2 feet) thick. Against this target a 19 centimeter (7½ inches) solid shot war fired, which penetrated it, taking with it not quite one-fifth of a cubic foot of composition, a very small quantity considering the size of the shot. But as soon as the shot had passed through the target the cellulose composition closed up again, and so firmly that a strong man was unable to force his arm through the opening made. A box filled with water was then fixed against the aperture, the contents of which ought to have acted in the same way as if the cofferdam had been washed by the sea. It was observed that a few drops of water began to percolate after the lapse of from ten to fifteen minutes, and even after the composition had become well saturated with water, only between three and five pints of water escaped per minute, which could be easily intercepted by pails. As soon as the cellulose had become thoroughly soaked and grown denser, it offered greater resistance to the percolation of water, which finally almost ceased to flow. The experiments with shell gave similar results, the breach made closed automatically. It was also found that the cofferdam was proof against fire. A special experiment was made in which red-hot coals were placed upon a mass of cofferdam, and covered with the same composition, the result being that the fire went out. The experiments with torpedoes were not so decisive as those who shot or shell. 'A chest was anchored out at sea, one side of which was lined with cofferdam, a torpedo attached to it and exploded. The chest floated for a few seconds and then sank. When fetched up by a diver it was found that the lid had been blown off but that the cofferdam composition was little injured. The above experiments appear to prove that the material in question possesses the property of automatically closing a leak caused by shot or shell and of protecting a ship to a certain extent against fire.

TOUGHENING TIMBER.—This is a new process by which it is claimed that whitewood can be made so tough as to require a cold-chisel to split it. This result is reached by steaming the timber and submitting if to end pressure, technically "upsetting" it, thus compressing the cells and fibres into one compact mass. It is the opinion of those who have experimented with the process that wood can be compressed 75 per cent. and that some timber which is now considered unfit for use in such work as carriage building could be made valuable by this means; and more especially since the rapid consumption of our best ash and hickory will sooner or later render some substitute necessary.

ENGINEERING NEWS Three months for One Dollar.

PERSONAL.

HIMES M. SMITH has been appointed assistant chief engineer of the work on the Rome and Carrollton railway.

W. H. PETTIBONE, formerly superintendent of the Chicago & Grand Trunk, has been appointed general superintendent of the T., C. & St. L., vice E. P. Murray, resigned.

GEORGE P. MERRILL, well known in connection with railroad enterprises in the West and in the manufacture of railway appliances in Toledo, O., died there on July 30th, of gastric fever, aged 37.

R. H. TALCOTT, the engineer who had charge of the building of the Cheasapeake and Ohio Road, has been appointed Superintendent of the Baltimore and Ohio bridge and line work at Philadelphia.

GENERAL W. B. HAZEN, Chief Signal Officer, left Washington on Wednesday for New York. On Thursday he sailed in the steamer *Brittanic* for Europe. During his absence Captain Francis B. Jones, Quartermaster's Department, will be acting Signal Officer.

MR. J. MILLER, has been appointed superintendent and chief engineer of *the Cincinnati, Lebanon & Northern R. R.* with headquarters at Cincinnati. He is a son of J. F. Miller, superintendent of the eastern division of the Chicago, St. Louis & Pittsburg.

WILLIAM M. CLEMENTS, who until recently occupied the position of master of transportation on the Baltimore and Ohio Road, has been appointed by President King general manager of the New York, Lake Erie and Western Road, and will assume the duties of the place on the 1st of August, Mr. Clements is a thorough railroad man and is well and favorably known throughout the country.

COE F. YOUNG has tendered his resignation as vice president of the Delaware & Hudson Canal company, to take effect as soon as his successor is chosen. Mr. Young has been with the company for twenty-one years, serving as assistant superintendent and superintendent of the canal, general superintendent of the company's rail roads, general manager and vice president. He retires from its service for personal reasons entirely.

CHANGES IN THE CORPS OF ENGINEERS. The following changes in the stations and duties of officers Corps of Engineers are ordered: 1st Lieut. Eugene Griffin will be relieved from duty at the U. S. Military Academy, West Point, N. Y., and will report in person to Maj. Gen. Winfield S. Hankock for duty as aid-de-camp. 1st Lieut Theodore A. Bingham will be relieved from his present duties as engineer officer Department of Arizona, and will proceed to St. Louis, Mo., and peport to Maj. Charles R. Suter, Corps of Engineers, president of the Missouri River Commission, for duty as secretary and disbursing officer of the commision, relieving 1st Lieut. Walter L. Fisk, Corps of Engineers, who, on being relieved, will proceed to West Point, N. Y. and report to the superintendent U. S. Military Academy for duty in the department of civil and military engineering.

A GEOLOGICAL SURVEY OF ALABAMA AND GEORGIA.—A party of engineers are now engaged in making a topographical and geological survey of the northeastern part of Alabama and the northwestern part of Georgia. They are at present operating around Rome. This is only one of twenty-five parties in the field in different sections in the United States. The main object of the survey is to get accurate maps of the United States, and also to get information of the mineralogical and agricultural resources of the country.

CORRESPONDENCE.

Why the English Cling to Old Weights and Measures.

Communicated to ENGINEERING NEWS.

Those persons who have been scolding the British and American people for their stupid indifference to the metric system can now know the reasons for their apathy. At last some grounds have been alleged for the attachment of the Englishman to his ancient units, besides the undeniable difficulty of every change.

In the Institution of Civil Engineers at London a paper entitled "A Comparison of British and Metric Measures for Engineering Purposes," has been discussed, as mentioned in the Periodical Literature Index, in a recent number of ENGINEERING NEWS; and although the majority of those who took part in the discussion favored the metric system, a valiant minority were true to their old usages, and presented some arguments that will be interesting to Americans.

As one comprehensive argument, decimal subdivision was condemned.

Sir Frederick J. Bramwell, the President of the Institution, quoted with commendation from an old speech in Parliament in which the following passage occurred:

"How are ordinary people to represent halves and quarters by decimal points? The symbol of a half is the figure "five," with a dot to its left hand; the symbol of half that quantity, that is of a quarter, is the sum twenty-five, also with a dot to its left hand. Arithmeticians understand how this can come about, and the symbols have grown natural in their eyes; but in what—even the most infinitesimal—degree do they tell their own story to the unlearned? What palpable relations towards each other can be disentangled out of these most frequently recurring symbols?"

Sir Frederick also dropped the remark that "in one sense, and in one sense only, was this calculation that had been placed before them typical of the metrical and decimal system—in the enlarged copy on the wall the decimal point appeared in the wrong place, as it always did."

Mr. J. W. Barry "could by no means adopt the recommendation of Mr. Aivy that the foot shall be divided into ten parts. It was a very great advantage that it was divided into twelve parts. Any one who has had much practical work would know the advantage of being able to divide the foot by 2, 3, 4 and 6. The decimal system was comparatively useless to a man who had to work with his hands, or for mental calculations, and, moreover, absolute correctness could not in many cases be obtained by it. By the duodecimal system absolute correctness could always be obtained."

Mr. E. W. Young lifted up his voice to the following effect. "Suppose a shopman wished to ascertain the cost of 17 yards at 5¾*d.*, he did not reduce 5¾*d.* to farthings, multiply by 17, and reduce back to pence and shillings, but he applied a process of mental arithmetic thus: he said, 'Why, that is 17 sixpences less 17 farthings, or 8*s.* 6*d.* less 4¼*d.* that is 8*s.* 1¾*d.*' It was done in an instant. Now if the decimal system were in force, and there were 25 farthings to the sixpence the shopman would have to multiply yards by farthings which would be far less convenient than the present system. Indeed for every little purchase made, the shopman would have to pull out pencil and paper to make a calculation." * * * * "With regard to the suggestion that twenty-five farthings would equal sixpence; that, he thought, would be a great disaster, because 24 could be divided by 2, 4, 8, 12, 6, and 3, and those numbers were again divisible by others. Altogether there were eighteen divisions and subdivisions, but 25 could only be divided once by 5."

As used to be said about war news, this is important if true. We Americans don't have twenty-five farthings in a sixpence, but an equally great disaster has befallen us; twenty-five cents (each worth two British farthings) make a quarter-dollar (worth two British sixpences). The harrowing spectacle of the the Yankee shop-girl pulling out her pencil to disentangle palpable relations out of these most frequently recurring symbols, while the tears rain from her eyes and make soft spots on her paper, appeals to American manhood for action. The present depression in business is no laughing matter, and, if it will revive our flagging industries, let us put twenty-four cents or twenty-four farthings or anything else into a sixpence, though decimal arithmetic perish from the earth!

It is a melancholy reflection that but few of the countless millions of our fellow-men can enjoy the blessed privilege of twenty-four farthings in a sixpence, only those who live in the United Kingdom and a portion of the British colonies. Dollars and cents are used in Newfoundland, in the Dominion of Canada, in British Honduras and some of the West Indian colonies, in Hong Kong, Singapore and Straits Settlements; rupees and cents are used in Ceylon and Mauritius. China and Japan, Russia and the continent of Europe, Mexico and South America have decimal coinage.

Another painful thought forced upon us is that the sufferers from decimalization don't know what is hurting them. The adoption of decimal coinage instead of non-decimal by the civilized and half-civilized world outside of the British Isles has been accomplished mostly during the last hundred years, in the face of the glorious example of twenty-four farthings in the sixpence, steadily held up by the leading nations of the world. Alas, foreign and colonial eyes have been blind to the superior intelligibility, accuracy and convenience of her mediaeval coinage. They don't understand but that the symbol $0.50 tells its own story to the unlearned in more than an infinitesimal degree; they don't appreciate that the decimal point always appears in the wrong place; and they don't realize that the decimal system is comparatively useless for mental calculations. Consider a single class of work. Americans who work with their hands, using chains, tapes and rods divided to decimals of the foot in surveying vessels, land, railroads, earthworks, etc., are too ignorant to be aware that, in comparison with inch-divided measures, their instruments are useless and incorrect. It is a crying shame that America is so benighted; and if Mr. Barry has any of the missionary spirit in his composition he should come over here and preach to railroad engineers upon the advantage of being able to divide the foot by three and six.

The most striking argument against the metric system presented at the Institution of Civil Engineers discussion, was that it is preferable to have weights and measures difficult to learn. Mr. Rodolph de Salis said: "It had been urged that the metric or decimal system was much easier to learn. No doubt it was, but surely that was not altogether an advantage. He would put it in the form of a proportion sum; as Greek is to French so is the English complicated system to the metric system in point of mental training." This was put forward in cold blood, and it was replied to in an ostensibly serious manner by Mr. Hamilton Smythe, who entered upon his answer with the remark that "the difficulties which English boys had to contend with in learning British arithmetic and measuration had, in many cases, developed mathematical capacities similar to those literary capacities which were supposed to have been developed by long and arduous studies of ancient Greek literature."

Mr. Ferdinand Hunter, P. C. D., also referred to this point as follows: "True it required more time to attain a knowledge of the English system and its special arithmetic at school, but that time was not lost, and the pupil who mastered the greater difficulties became the better man in the end."

This argument is based on invincible logic. Grant that a confusing variety of disconnected units is desirable, and the conclusion must follow that the old English weights and measures should be adhered to. This argument ought to receive the earnest attention of American teachers and school boards, and if they can strengthen the minds of future generations by putting additional stumbling blocks in the children's educational paths, the business ought to be attended to without delay. Perhaps it would be well to have all school-books printed in old English black letter, like German text, so that one letter would be easily mistaken for another, or to write all numbers in the I, II, III, IV, V style, used on old tomb-stones and watch-dials.

It is delightful to observe, by the way, amid the conflict of assertions, and opinions upon most points, that as to the facility with which the metric system can be learned, its friends and opponents were agreed.

Another very neat argument adduced by our conservative friends is that the old units present relations to one another which are handy for dealing with some common things, and especially with iron. Sir Frederick Bramwell expatiated upon this subject, and the following quotations are from the report of his remarks: "He desired to be permitted to refer to the numberless short cuts in mental calculations given by the present system." * * * * * "1 inch of rain to the acre was 100 tons, or, to be more accurate, 101 tons." Probably the reason why this is preferable to the metric system, where one centimeter of rain to the hectar is accurately 100 metric tons, is because the inch per acre amounts to over 113 tons of 2000 pounds, or "colonial" tons, as our Brittish cousins say.

It was high time to call attention to the priceless value of those ancient coincidences, for already they have begun to be lost through our negligence. One has already passed away which was handy in dealing with so common a thing as beer. A pipe, 1 inch in diameter, holds that or any other fluid at the rate of ten yards length per beer gallon; yet where is the beer gallon now? Forbidden, outlawed, its use, and in some cases, even its possession punishable by a fine! If a sense of the irreparable injury this has caused to all English-speaking people be not indignantly expressed, how soon may not the ten yards follow the beer gallon into oblivion? Let a wail be heard from London to Fiji, from Khartoum to Hoboken.

LITERATURE.

A Manual of Topographical Drawing, by LIEUT. R. S. SMITH, U. S. Army, late Assistant Professor of Drawing in the U. S. Mil. Acad., West Point, N. Y. Revised and enlarged by Charles McMillan, C. E., Professor of Civil Engineering, College of N. J. John Wiley & Sons, Publishers, New York, 1885. 8vo. pp. 112. Price $2.00.

This is a republication of Prof. Smith's excellent Manual of 1854, with extensive additions to the text, newly drawn illustrations and a general revision bringing the practice up to date. Prof. McMillan's efforts in this new edition have been especially directed towards the production of a book, which would be of service to those who sought to teach themselves. In this we believe he has thoroughly succeeded, and the product is a work particularly useful to the topographical draftsmen or engineer. All the illustrations are well made and are selected from such standard authorities as the U. S. Coast Survey, etc., the colored topography is particularly handsome.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 77*).

Fig. 113, is a set of plans for a watchman's shanty. The building should be large enough to accommodate a small stove, and give room for the watchman. The diagrams need no explanation except to notice that the roof as also that of the tool house is of corrugated iron instead of ordinary shingles, in order to reduce chance of fire.

For a dwelling shanty there is needed an economical, yet comfortable building capable of accommodating a family. This idea seems to be realized in the plans shown in Fig. 114. The construction is simple, the building being built with a "balloon" frame. Down stairs there is a kitchen, pantry, nice sittingroom and two bedrooms; while upstairs there is a large attic which can be cut up into two bedrooms, and a storeroom over the kitchen. The rooms are all well lighted. Appended is a bill of material.

Pine	672 ft. B. M.	Butts.....	10 pair.
Oak	8 "	Door knobs.....	2
Hemlock...	9234 "	Hinges	1 pair
Pine shingles	6000	Sash bolts.....	2 doz.
Nails.....	242 lbs.	Screws	27 "
Windows (12 lights 8" × 10")-8		Paint (dry metallic)	50 lbs.
Locks	2	Oil.....	12 gals.
Latches	6	Japan dryer.....	1 "
Carpenters labor		46 days	
Painters "		3 "	

An excellent color for all these buildings is a dark red.

GAUGE, LINE AND SURFACE.

The three essential properties of good track are correct gauge, line and surface. The proper distance between the rails must be exactly preserved everywhere except on sharp curves, where it is to be evenly increased as will be hereafter explained. An allowance of ¾ inch is made in the wheel gauge which is sufficient for easy clearance, and allow the truck to be properly guided without swaying, while if the gauge of the track is wide and especially if irregular the trucks are no longer restrained and a disagreeable lateral position is imparted to the train damaging both it and the track.

There are those who prefer to contract a gauge at frogs and on bridges with the view of reducing to a minimum the lateral play of the trucks. As was mentioned before in respect to frogs and is repeated now for bridges, this is unnecessary. If the track is of the proper gauge the ¾ inch allowance in wheel gauge is not sufficient to produce an injurious side motion. On the other hand it does produce irregularities in alignment and depreciates in the mind of trackmen the value of the gauge as an exact instrument. Unless the gauge is uniformly correct, perfect alignment is impossible. Wherever the track is out of line a lateral concussion is given to the train, which, repeated by each wheels of every train, keeps on forcing the track more and more out of place. Car springs are so arranged as to either destroy or greatly reduce the shocks of vertical irregularities, but there is no commensurate allowance made to soften the defects of line. Let the error of alignment be but small, yet each wheel as it meets the deflection is violently thrown laterally, producing in the car, to the discomfort of its occupants, those sharp, quick swings, apparently almost the result of a blow. Therefore true alignment is a necessity, and to obtain it our gauge must be exact, so that both rails shall be true. So important is correct alignment that on all roads ambitious for a perfect track it should be marked by permanent monuments set, say every 300 feet on curves and every 500 to 1,000 feet on tangents. Where track which is out of line and is to be put in shape, the correct line should be given by transit, plugs being set not over 100 feet apart. Mark the center of a track gauge by driving a nail through it, and throw the track until the point of the nail is over the tack in the plug. Repeat this operation at each of the plugs and line between them by eye. If the track is double, set stakes for the center of one only, then after that track is lined throw the other to correspond by means of a long gauge adjusted to fit the clear space between the two inside rails. By these means, track is more quickly, easily, and of course, more correctly lined, than can be done by a track foreman's eye.

(TO BE CONTINUED.)

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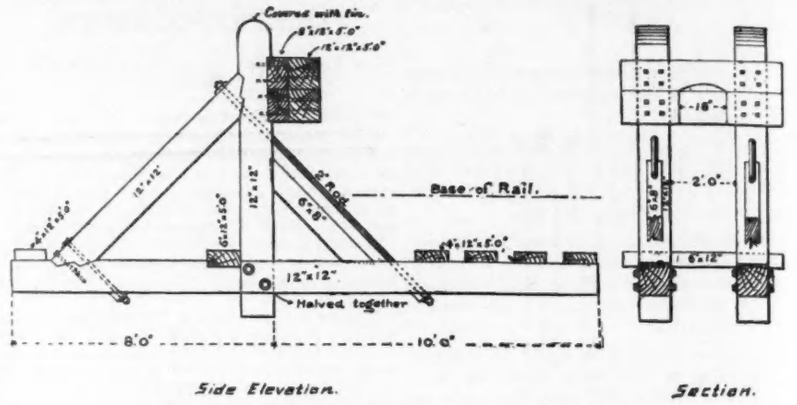


FIG. 109.—BUMPING BLOCK.—*See page 60 of "Track."*

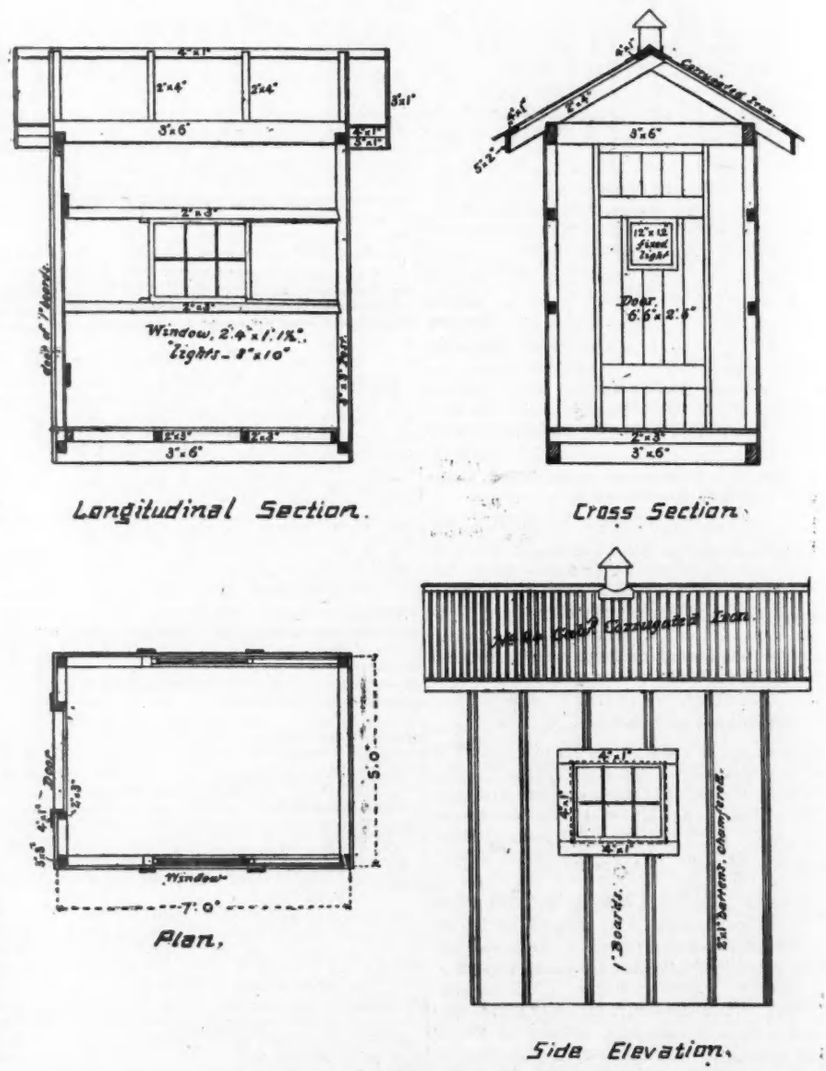
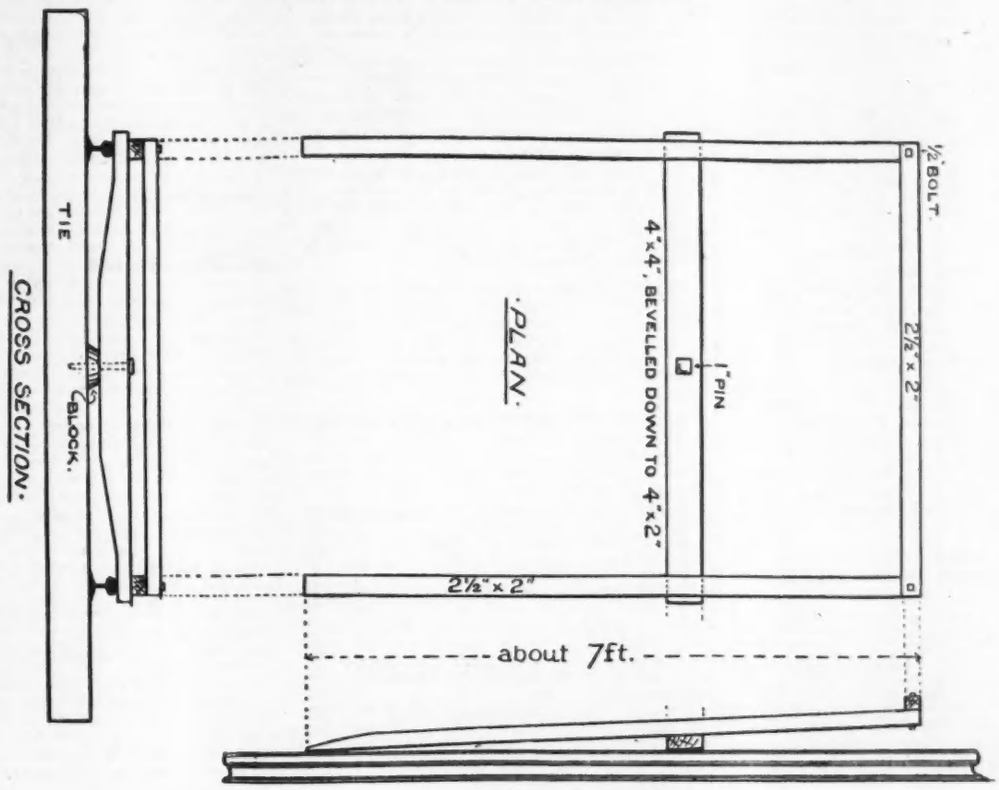


FIG. 113.—WATCHMAN'S SHANTY.

FOOT NOTE.—Figs. 109 and 110 have been reversed in "Track." Fig. 109 is the "Bumping Block" referred to on page 60. The "Mail Crane" should be Fig. 110.

FIG. 112.—HAND-CAR TRANSFER FRAME.



WATER.

BLAIR, Neb., is talking up water works with wind mill pressure.

DUBUQUE, Ia., has contracted for the boring of artesian wells to secure a water supply.

THE water furnished to South Pueblo, Col., now comes from the lake near Bessemer. No water has been pumped from the river since the flood.

PLATTSMOUTH, Neb., is now talking up water works, under the illusion that the construction of a system would reduce insurance rates.

THE drainage question at Fremont, Neb., has been tackled in a business way, and surveys and plans prepared for active work.

THE City Council of Brunswick, Ga., have unanimously decided to accept the proposition of Messrs. Jeter and Boardman to erect water and gas works, provided these gentlemen agree to a few minor amendments to the original proposition, the most important of which is the placing of five instead of three drinking fountains at the disposal of the public, and increasing the distances of street lamps and fire-plugs from each other twenty-five and fifty feet respectively.

A MOVEMENT is on foot to irrigate the valley lands lying along the Rio Grande above San Antonio, Tex. which, if carried out will prove one of the most profitable investments ever made in this country, as there is a market here and in the adjoining cities along the line of the Mexican National Railway in Mexico, now supplied from San Antonio and cities in Central Texas which could be supplied here were the land irrigated and agriculture made practicable.

THE work of digging trenches at Fon du Lac, Wis., for the water works, has commenced on South Main street, a small force of men being employed. It is proposed to increase the number to 200 in a few days. One dollar per section for trenching for four, six and eight inch pipe, $1.10 for the ten inch, $1.15 for the fourteen-inch will be paid. The standard depth of the trenches will be six feet, measuring to the centre of the pipe.

CHIEF ENGINEER LUDLOW, of the Philadelphia Water Department, thinks there is no good reason for the increase in water consumption from 56 gallons per head in 1860, to 73 gallons in 1884. He regards 40 gallons as a legitimrte per capita supply. Since 1810 there has been the following increase per head in the consumption of water:

	Gallons.		*Gallons.*		*Gallons*
1810	7	1840	20	1870	55
1820	16	1850	21	1880	68
1830	17	1860	36	1884	73

THE commissioner of Public Works of Chicago, Ill., has been instructed by the council to advertise for bids for two new engines for the North side waterworks. Commissioner Cregier recommended two years ago that this be done. It is proposed to put in engines having a capacity of ten to fifteen million gallons each, which will be placed in a wing adjoining the main building, the old engines to be retained. The plans for the new engines have been partially made. The purchase of new engines has become a matter of necessity, as it is difficult for the present pumps to meet the requirements, under some circumstances.

THE New Croton Aqueduct Commissioners met July, 29th, and awarded the contract for section No. 1 of the new aqueduct. It consists principally of a large gate house and channels to connect the new aqueduct with Croton Lake. There were ten bidders, and their bids were:

Smith & Brown	$442 750.00
Malone & Matthews	451,575.00
Douglass & Dalzell	456,057.50
John Cox & Co	485,539.50
Beckwith & Quackenbush	486,600.00
P. P. Dickinson	487,665.00
O'Brien & Clark	518,900.00
Wm. Nolan & Co	520,655.00
Collins & Farwell	542,000.00
Brown, Howard & Co	765,360.00

The contract was awarded to Smith & Brown. Their sureties are ample.

THE STRANGE WATERS OF UTAH.—There is in the extreme north of Utah, a magnificent subterranean reservoir of first class soda water, bubbling and effervescing out of the ground in such quantities that all America might be supplied. In the extreme South, on the road to Oderville, is an exquisite circular lakelet that is always just full to the brim with water, as clear and as green as beryl. And wherever the water overflows the lake's edge, it incrusts the ground and the grass and the fallen leaves upon it with a fine coating of limestone, so that the brim is perpetually growing higher and higher with the imperceptible but certain growth of a coral reef, and in course of generations the lake will become a concreted basin. Between these two points are scattered all over the country, springs and pools of the strangest waters. There is one pool only a foot deep, and situated at a high altitude, that refuses to freeze even in the severest winters. There is another that mysteriously replenishes itself with half-grown trout. One stream that I saw, though clear as crystal to the eye and tasteless, stains all the vegetation it flows over a deep brown. A warm spring near Salt Lake City is the strongest sulphur water in the world. A "hot spring," a few miles off, with water so hot that you can hardly put your hand into them and as bright as diamonds, is one of the most remarkable combinations of chemicals ever analyzed.—*Boston Budget.*

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The North Shore Road of Canada was transferred to the Canadian Pacific Company, July 31st, in accordance with the recent resolutions of Parliament.

The Burlington will complete this season 200 miles of new line into what has been heretofore Union Pacific territory.

A Bridge at Davenport, Ia.—The Chicago, Burlington & Quincy railway company is said to be contemplating the bridging of the river at Davenport, Ia.

Manchester Ship Canal.—The committee on the Manchester Ship Canal have passed the preamble of the Bill. The chief conditions are that the canal shall begin at Eastham lock, and be dredged to a depth of fifteen feet, and that the company shall raise $25 000,000 capital.

New Railroad Projects.—MILWAUKEE, WIS., July 24th.—The announcement that the Wisconsin Central Company had made arrangements for terminal facilities at Chicago has given rise to several rumors of new railway projects. Among them is the report that the Chicago, Milwaukee & St. Paul Company will now carry out a plan projected years ago to build an extension north from Merrill to Ashland. Such an extension would go through a section of country noted for its pine and across the Penokee iron range. Another rumor is that the old charter of what is known as the Beloit Line, running between Milwaukee and Beloit, is to be revived by the Northwestern Company. A good portion of this line was graded years ago, but this is as far as the project was carried.

Canadian Railroad Projects.—MONTREAL, Aug. 1st.—The agent here of the Northern Pacific Railroad received information yesterday that the new bridge between Duluth and Superior City, is completed and open for traffic. This gives the Northern Pacific another terminus on Lake Superior at Ashland.

The Grand Trunk Railroad Company project an extension of their midland system to Saulte Sainte Marie, where connection is made with the Detroit, Mackinac, and Marquette Railroad which is now completed to Humboldt, leaving but a small gap between Humboldt and Ashland. This will form a through line from eastern Canada to the American northwest, south of Lake Superior. The difference in distance by this route as against the present route by way of Chicago, will bring Montreal about 400 miles nearer the Northwestern States.

English Tramways.—The authorized capital of English tramway companies is over $80,000,000, and of this sum about $55,000,000 has been expended. The companies generally seem to be in a prosperous condition, and the gross and net receipts show encouraging gains. The net returns for the past year on the capital expended show an average of more than 5 per cent. a, compared with 4¾ per cent. for the previous year. At a recent meeting of the London Tramways Company the chairman stated that the company was assisting the poor by carrying people a mile and a half for 1d. and three-quarters of a mile for ½d. He also stated that if the company had continued the 2d. fares it would be in the same condition as the old company, which paid no dividend, whereas this paid £45,000 a year.—*Bradstreets.*

English Baggage Rates.—The weight now allowed for free baggage and the charges for excess baggage by the English railway companies are as follows:

First class, 120 lb.; second class, 100 lb.; third class 60 lb.; and above these weights the companies will charge for distances above 300 miles, 1d. per lb.; 150 to 300 miles, ¾d. per lb.; 50 to 150 miles ½d. per lb.; under 50 miles, ¼d. per lb.

Weight of Fast Trains.—Mr. J. O. Crawford, Superintendent, gives the following as the approximate weights of the fast trains on the New York division of the Pennsylvania Railroad:

	Pounds.
Engine, ready for service	96,700
Tender, ready for service	56,300
Two men on engine	300
One (1) combined car	30,000
One (1) parlor car	50,000
Two (2) passenger coaches	88,000
140 passengers, estimated	21,000
	342,300
Coal, estimated	5,000 lb.
Water	3,700 galls.
Average schedule speed, miles	48.01
Maximum schedule speed per hour, miles	55.08
Distance from Jersey City to Philadelphia, miles	89.06

The Northwestern's New Black Hills Route.—The Chicago & Northwestern Railway gives notice that its Fremont, Elkhorn & Missouri Valley Railroad (Elkhorn Valley Line,) now being extended, will be completed and opened for business Aug. 9th, to Chadron, in Dawes County, Neb., making the line, when thus completed, continuous from Missouri Valley up the entire length of the Elkhorn River to its source, thence crossing the Long Pine, Plum, and Evergreen Creeks to the Niobrara River in Cherry County, thence following the course of the Niobrara River to the now well-known Government free lands called the Antelope Flats, the Rush Creek Valley, the Hay Springs District, the Bordeaux Valley, and into the Valley of the White River, in Northwest Nebraska, opening up the new stations of Crookston, Georgia, Cody, Eli, Merriman, Irwin, Gordon, Rushville, Hay Springs, Bordeaux, and Chadron. From Rushville to Pine Ridge Agency is twenty-four miles north; from Chadron to Buffalo Gap Hot Springs, fifty miles northwest; from Chadron to Rapid City, Dak., ninety miles north; from Chadron to Custer City, Dak., seventy-five miles north; Chadron to Deadwood, Dak., 135 miles northwest; from Chadron to Fort Robinson, Neb., twenty-eight miles southwest; from Chadron to Fort Laramie, Wyo., 125 miles west. Stages will run from Chadron to Rapid City and Deadwood regularly, connecting with arrival and departure of trains; diverge at Rushville for Pine Ridge Agency

The Kentucky and Indiana Bridge.—The Cincinnati *Enquirer* gives the following notes on the proposed erection of the above bridge:

An iron span will be built on the scaffolding, and then a novel method of construction will be pursued. The bridge is a "cantilever" and the iron work is all above the floor. The spans between piers Nos 7 and 8 and between Nos. 5 and 6 are 500 feet in length. Now, as soon as the 360-foot span between piers Nos. 6 and 7 is completed, the iron work will be built out 180 feet south from pier Nos. 7 and north from pter No. 6. No false work will be necessary, as the iron work is so joined together that each section of 180 feet will balance an equal section on the other side of the pier. Or, in other words, piers 6 and 7 will bear 350 feet of iron work, the two sections each of 180 feet exactly balancing each other. The piers, it should be explained, are numbered from north to south. When the bridge reaches this stage of construction there will be sections 180 feet in length projecting out in mid air, without any visible means of support, and the interesting work will doubtless be watched by a good many curious people.

The longest spans, as mentioned above, are 500 feet. After constructing the iron work out for for a distance of 180 feet from each pier, as described, there will still remain gaps of 140 feet. This chasm will be crossed by constructing a light wooden bridge across it, and the placing of the iron work upon the temporary wooden structure. The idea is, in brief, to erect as little scaffolding as possible and to make each part of the iron structure do duty in balancing some unconstructed portion.

The piers of the bridge are splendid specimens of masonry. They are twice as broad as those of the old bridge. The tallest of them is 121 feet high. President Macdonald, of the Union Bridge Company, says it is the finest masonry he ever saw in any bridge.

Burlington & Missouri R. R. has now over six hundred miles of road in Nebraska, and is still building. This year, however, it will construct about 100 miles. Thirty-six miles of that is in Nebraska, and the balance in Kansas, running out from Marysville to Oberlin.

French Railroads.—France has now 31,000 kilometers of railways, conveying 180,000,000 passengers a year; and the gross receipts are 1,150,000,000 francs. Two hundred and twenty-three thousand persons are employed on these railways, and the State derives a revenue of 83,000,000 francs from them.

The Toledo, Columbus & Southern, formerly the Toledo & Indianapolis road, will be completed to a connection with the L., B. & W. road at Findlay, by the middle of August. The road is forty-five miles in length, and to get into Toledo uses the terminal facilities of the Ohio Central road.

The German Railroads have steadily decreased their profits since 1879. The Austrian roads, on the contrary, have slowly increased their net earnings from 4.03 per cent. in 1876, to 4.76 in 1883. The Dutch railroads, which are well managed financially, have also increased their profits in the last four years from 3.46 to 3.90 per cent.

The Glasgow Bridge.—Work is now well under way on the approach of the great steel bridge of the Chicago & Alton Railroad Company across the Missouri river, at Glasgow, Mo. The object of the company is to save the first pier of the bridge from the strain incident to a heavy grade, and it is considered that this object will be accomplished by raising the approach track and grade for a mile east of the bridge. The cost of the work is estimated at between $30,000 and $40,000.

The Elkhorn Valley extension of the Sioux City and Pacific, under Northwestern auspices, has reached Chadron, and regular passenger and freight trains will be run to that point on and after August 2d. A contract has been let for the grading of the road between that point and Rapid City, in the heart of the Black Hills, a distance of 103 miles. This will be completed early in 1886. Surveyors are in the field in Northwestern Wyoming, and it is believed 300 miles will be added to the road in less than a year.

Chicago, Milwaukee & St. Paul R. R.—The mileage of the Chicago Milwaukee and St. Paul, increased 240 per cent. from 1877 to 1884, while its stock increased only 71 per cent, and its bonded debt only 23.43 per cent. During the same time the earnings increased 189.2 per cent, and the operating expenses 205 per cent. The freight carried one mile increased 396 per cent. The receipts per ton per mile fell off in five years only 38 per cent, and the receipts per passenger mile decreased only 20.5 per cent.

Another Mexican R. R.—A new railroad enterprise in which it is reported Kansas City capital will be largely interested, is now on foot in old Mexico. Since the building of the Mexican Central, various railroad schemes have been projected in Mexico, but none, as yet, have been projected into the territory proposed to be reached by the one in question. This new road will cross the continent from east to west, from Matamoras, on the Gulf of Mexico, to Mazotlan, on the Pacific coast, following closely to the line of the Tropic of Cancer.

A Duluth Line.—DULUTH, MINN., July 29th.—A party of leading capitalists and lumbermen of Wisconsin, are interested in the Hayward, Superior & Southern Railroad, which is to be built from Hayward, in Sawyer County, Wis., to Superior and Duluth, with a southern line extending from Hayward to Chippewa Falls, where, or at Eau Claire, which is near by, it will connect with the Chicago, Milwaukee & St. Paul Railroad. The people on the route of the proposed road are very much in favor of its speedy construction. Tuesday, Sawyer County, Wisconsin, voted by a large majority to bond the county to the extent of $70,000 in aid of the road.

A Chesapeake and Nashville Branch.—NASHVILLE, TENN., July 29th.—The Chesapeake and Nashville Railroad Directors contemplate the construction of a branch line from Gallatin to the Upper Cumberland. By this branch road the management will be able to reach a vast area of timbered land. The line will pass through the oil regions of Southern Kentucky which are already being developed by men from Pennsylvania, who are boring and plugging up wells for when the road shall have been built to them. The immense coal-fields are also to be developed, this giving to Nashville an additional supply of some of the best coal in America.

The Beech Creek, Clearfield & Southwestern road, which Vanderbilt has sold out to the Pennsylvania Company, was built recently in the interests of the New York Central and Philadelphia & Reading roads, and as a competitor of the Pennsylvania lines. It extends in a southwesterly direction from Jersey Shore to Ansonville, Clearfield county, Pa., a distance of 103 miles. At Jersey Shore it connects with the Fall Brook Company,s lines, and over them with Geneva and Lyons and other roads with the New York Central. It also connects with the Jersey Shore, Pine Creek & Buffalo Railway. The Pennsylvania Company is to get 60 per cent. of the stock.

Russia's Railway.—The Central Asiatic Railway will now be pushed forward very energetically, in pursuance of the imperial order of the 5th instant. Gen. Annenkoff, charged with the direction of the necessary works, has already started for the Transcaspian, and will be there before you receive this letter. Great attention is paid in Russian circles to this railway, which will be of the utmost importance, not only strategically, but also in its relation to commerce. The line will go in a direct southeastern direction to Kakhka, which place is about half way between Askabad and Sarakhs, but then the road will take a northeastern direccion to Morv, and further to Bourdalik, on Amu-Daria. In this way the railway, which has hitherto closely followed the Parsian frontier, will suddenly branch off at an angle and be continued to a distance of about fifty miles from the new Russo-Afghan boundary, which is thought will be settled by the negotiations between England and Russia. The considerations which have determined the government to choose this direction for the railway are commercial ones, and the line now will be connected with the principal fluvial communications in the Russian possessions in Central Asia, also with the great caravan roads. The expenses of keeping up the railway will be serious. They are calculated at nearly 2,000,000 rubles a year, and during the first year or two the receipts will scarcely amount to 200,000. After that time, when the Central Asiatic merchants have learned to appreciate the new means of communication, the traffic may be expected to largely increase. It is said on good authority that the Central Asiatic Railway will be continued next year across the Bokharian territory to Samarcand, and from thence to Tashkend, the residence of the Turkestan Governor General. The distance between the towns is 260 English miles.—*London News.*

The Railroads of the Country.—The introductory sheets of *Poor's Railroad Manual* for 1885, were issued this week. The *Manual* itself will be out, it is expected, in about a fortnight. It will contain a mass of interesting facts and some significant comments on the existing condition of railroad property in this country. The total number of miles of railroad in the United States at the close of 1884, was 125,379, of which 3,977 miles were constructed during the year—the rate of increase being 3.17 per cent. The number of miles making returns of their share capital and funded and floating debts equaled 125,152, against 120,552 for 1883, the increase being 4,598, the rate of increase being 3.8 per cent. The share capital of the mileage in operation in 1884 equaled $3,762,616,689, against $3,708,080,583 in 1883, the increase equaling $54,566,103, the rate of increase being about 1.4 per cent. The funded debts of all the lines at the close of the year aggregated $3,669,115,772, a sum $168,245,858 in excess of the total of 1883, (3,500,879,914,) in increase of nearly 5 per cent.

The gross earnings or receipts of all the lines from which returns were received for the year equaled $770,684,908, of which $206,790,701 were received from transportation of passengers $502,869,910 from transportation of freight, and $53,749,997 from the transportation of mails and express matter, from investments, and from the sales of lands applicable to the payment of interest or dividends. The gross earnings of all of the lines for the year ending Dec. 31, 1883, exceeded those for 1884 by $53,088,016. The net earnings of all the lines for 1884 equaled $268,106,258 against $299,367,285 for 1883, the rate of decrease being about 9 per cent. The amount of interest paid in 1884 equaled $176,694,302, against $173,139,064 in 1883, the increase being $3,555,238, the rate of increase equaling more than 2 per cent. The amount paid in dividends in 1884 equaled $93,244,835 against $102,052,518 in 1883, the falling off equaling $8,807,713, the rate of decrease being about 8.8 per cent.

The *Manual* says that the general demoralization which has prevailed in railroad circles is due more to construction of the "Nickel plate" and the West Shore Roads (and to the ill fortune which attended them) than to any other cause. Their effect has been to stop altogether the payment of dividends which had been paid for a long time by the Lake Shore and the Michigan Central Companies. The *Manual* says:

"Although West Shore and 'Nickle Plate' seemed to be the occasion of the great catastrophe of 1883 and 1884, the real causes had been long at work in the wonderful success of signal instances of 'watering,' of which the Pacific lines, the New York Central and Lake Shore are striking examples. The real catastrophe occurred when these waterings took place. Incited by their success our whole people became wild upon the subject of railroad construction, believing that $2 or $3 dollars could easily be made for every dollar put up, either by the success of their ventures, or by the sale of their securities. In this mania or delusion the capitalists and the adventurer alike shared. The promoters of West Shore, men of capital, put up their money in good earnest under the idea that they were embarking in an honorable and meretorious enterprise. The promoters of 'Nickle Plate' built their line on speculation, and for the purpose of selling it, securities being issued at the rate of $2 to $3 for every dollar of cash paid. No small portion of the 40,000 miles constructed in the five years ending with 1883, was built upon the same plan and with the same object. Whatever their fate, a large number of them became competitors for a business for which am-

BIDS ON GATE HOUSE NEW CROTON AQUEDUCT—OPENED JULY 29, 1885.

SECTION 1.

No.	Name of Bidder.	2,000 Cubic Yards Earth Excavation.	99,000 Cubic Yards Rock Excavation.	450 Cubic Yards Subaqueous Rock Excavation.	7,000 Cubic Yards Tunnel Excavation	3,800 Cubic Yards Brick Masonry.	800 Cubic Yards Concrete Masonry, 5 Broken Stone to 1 of Cement.	500 Cub. Yds. of Concrete Masonry formed of 3 parts of Broken Stone to 1 of Cem't.	6,500 cubic yards Rubble Stone Masonry.	11,000 Square Feet face work of Rubble Stone Masonry.	360 Cubic Yards of Paving.	3,500 Cubic Yards cut facing Stone Masonry.	1,000 Cubic Yards dimension Stone Masonry.	10,000 Cubic Yards cut backing Stone Masonry.	60,000 Square Feet, rough pointed face dressing.	14,400 Square Feet Fine Hammer (6 Cut) face dressing.	1,000 Cub. Yds. Masonry of all kinds, for which an addi'l price is to be paid.	1,000 Cub. Yds. Masonry, of all kinds, for which an addi'l price is to be paid.	400 Linear Feet Drain Excavation.	Total
		a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.	o.	p.	q.	r.	Total
		$ 900	78160	9000	50750	41800	4200	3000	34125	2530	2450	76125	41500	170000	21000	9360	1000	500	600	542,000.00
1	Collins & Farwell	$0.45	1.24	20.	7.25	11.	5.25	6.	5.25	.23	7.	21.75	41.50	17.	.35	.65	1.	.50	1.50	
		1000	88500	2250	45500	41800	4600	3375	29250	5500	4200	56000	26000	115000	18000	7200	1750	1250	400	451,575.60
2	Malone & Mathews	.50	1.50	5.	6.50	11.	5.75	6.75	4.50	.50	12.	16.	26.	11.50	.30	.50	1.75	1.25	1.	
3	Beckwith and Quackenbush	560	70800	2700	42000	41800	4000	3000	39000	5500	6300	91000	30000	130000	12000	5040	1750	750	400	486,600.00
		.28	1.20	6.	6.	11.	5.	6.	6.	.50	18.	26.	30.	13.	.20	.35	1.75	.75	1.	
3	Beckwith and Quackenbush	600	103250	2700	42000	41800	4800	2503	39000	5500	6300	91000	30000	130000	12000	5040	1500	750	400	519,140.00
		.30	1.75	6.	6.	11.	6.	5.	6.	.50	18.	26.	30.	13.	.20	.35	1.50	.75	1.	
		900	103250	1800	42000	40280	4640	3000	48750	1100	2187.50	52500	31000	95000	18000	7200	2000	1250	1200	456,067.50
4	Douglass & Dulzell	.45	1.75	4.	6.	10.60	5.80	6.	7.50	.10	6.25	15.	31.	9.50	.30	.50	2.	1.25	3.	
5	Brown, Howard & Co.	1000	118000	22500	56000	49400	5600	4000	48750	8250	4200	105000	45000	250000	30000	12960	2500	1000	1200	765,360.00
		.50	2.	50.	8.	13.	7.	8.	7.50	.75	12.	30.	45.	25.	.50	.90	2.50	1.00	3.	
		600	109150	6750	49000	41800	3600	2500	29250	5500	3500	131250	14000	80000	30000	10800	500	500	200	518 900.00
6	O'Brien & Clark	.30	1.85	15.	7.	11.	4.50	5.	4.50	.50	10.	37.50	14.	8.	.50	.75	.50	.50	.50	
		600	94400	4500	45500	38000	3600	2750	30875	5500	700	80500	43000	140000	18000	10040	1250	800	600	520,655.00
7	Wm. Nolan & Co.	.30	1.60	10.	6.50	10.	4.50	5.50	4.75	.50	2.	23.	43.	14.	.30	.70	1.25	.80	1.50	
		400	79650	3600	38500	38000	3800	2625	32500	3300	2100	75250	30000	149000	18000	8610	1250	750	300	487,665.00
8	P. P. Dickinson	.20	1.35	8.	5.50	10.	4.75	5.25	5.	.30	6.	21.50	30.	14.90	.30	.60	1.25	.75	.75	
		1000	132750	8100	42000	51300	4140	303750	36010	1485	3578	54670	19130	103500	16200	6480	900	540	720	485,539.50
9	John Cox & Co.	.50	2.25	18.	6.02	13.	5.17½	6.07½	5.54	.13½	10 22	15.62	19.	10.35	.27	.45	.90	.54	1.80	
		600	147500	3600	35000	38000	3200	2500	35100	1650	2100	38500	40000	80000	9000	3600	1500	500	400	442,750.00
10	Smith & Brown	.30	2.50	8.	5.00	10.	4.	5.	5.40	.15	6.	11.	40.	8.	.15	.25	1.50	.50	1.	
	Engineer's Estimate.	1000	103250	4500	49000	45600	4000	3000	32500	8800	2800	63000	30000	110000	15000	10800	1000	1050	400	485,650.00
11		.50	1.75	10.	7.00	12.	5.	6.	5.	.80	8.	18.	30.	11.	.25	.75	1.	1.	1.	

NOTE:—Each bid as above gives the total price for each item and the unit price.

ple provisions had already been made by existing lines."

The opinion is advanced that the non-competing lines must await the steady and certain increase of the general business of the of the country; the competing ones must be taken up by the lines they parallel and used as side tracks, or made servicable in some other manner as best they may.

The New York Central Railroad has had its line resurveyed, and the new distance from New York to Buffalo is 438 miles, against 452, the old measurement. A smart newspaper man up in Utica thinks this saving of fourteen miles will enable the trains to make half an hour better time.—*Ex.*

The South Penna. R. R. Syndicate.—From a well-informed gentleman connected with the company in another city, the following list of the original subscribers to the South Pennsylvania has been obtained: J. B. Lippincott, $100,000; E. C. Knight, $200,000; John Kean, $100 000; Ralph Bagaley, $1,000 000; F. B. Gowen, $100,000; Henry Lewis, $100,000; I. V. Williamson, $100,000; C. & H. Borie, $200,000; L. K. Sheldon, $50,000; W. H. Vanderbilt, $5,000,000; H. W. Oliver, $1,000,000; D. O. Mills, $500,000; O. H. Payne, $500,000; W. C. Whitney, $250,000; A. S. Hewitt, $100,000; S. B. Elkins, $100,000; C. Meyers, $250,000; H. C. Frick, $250,000; D. Hostetter, $2,000,000; H. Phipps, Jr., $500,000; J. B. Houston, $50,000; E. G. Ferguson, $250,000; B. F. Jones, $200,000; J. W. Chalfant, $50,000; Mark W. Watson, $100,000; Augustus Schell, $100,000; A. Carnegie, $1,000,000; J. W. Brookman, $250,000; J. B. Colgate & Co., $50,000; George I. Magee, $50,000; Willian N. Riddle, $150,000.

Ninth Street Tunnel.—Mr. C H. Waring, Chief Engineer of the East Tennessee, Virginia & Georgia Railroad, was in Chattanooga, Tenn., July 24, to close all negotiations for the building of the tunnel under the E. T. tracks at their intersection with East Ninth street. The city agrees on its part to make the excavations and erect the abutments, the railroad company to build the superstructure and keep the tunnel in repair. The matter is now definitely closed, and the contract will be awarded at an early day.

The walls of the tunnel will be first class mason work, 56 feet in length at the top and 100 feet at the base 4 feet thick at the top and 5 feet at the base; the height will be about 25 feet. The roadway between the abutments will be 30 feet, with 5 feet on each side for walks. The superstructure will consist of plate girders; the rail will be laid within the girder. The structure will be very massive and strong.

As soon as the tunnel is completed Ninth street will be widened 10 feet along its entire length, the property owners on each side having donated 5 feet. The work is one of considerable importance.

Railway Dividends in Europe.—An exchange publishes the following statement in regard to the earnings of certain railway systems:

"The recently-published statistics of the German Railroad Union for 1883 gives as follows the percentagus on the capital invested earned by different gronps of railroads for successive years:

Railroad.	1879.	1880.	1881.	1882.	1883
German	5.41	4.48	4.49	4.72	4.63
Austrian-Hungarian	4.03	4.15	4.40	4.70	4.76
Dutch and other	3.46	3.82	3.82	4.53	4.90
Total Union	4.22	4.23	4.42	4.70	4.69

"The profits of the German roads tend to decrease possibly because they are become mostly state lines which are not intended to yield a large profit. The profits of the lines in Austria Hungary and elsewhere increase pretty steadily. The largest profit by a German railroad in 1883 was 9.59 per cent., by the Right bank of Oder railroad. Four German roads earned more than 8 per cent., two more than 7 per cent., but no other earned as much as 6 per cent., while fourteen earned less than 3 per cent. in Austria the highest rate of profit was 16.12 per cent. by the Emperor Ferdinand Northern, and the next 9.40 per cent., while three others earned more than 8 per cent., two more than 7, and seven others more than 6 per cent. But 26 earned less than 3 per cent., 20 less than 2 per cent. and 8 less than 1 per cent. In Poland, the Warsaw and Vienna railroad earned 13 per cent.; the one great Belgian Company road earned 5.53 per cent., one Dutch road 6¼, and another 6½."

Contracting.

A Nebraska Bridge.—Fullerton, Neb., has voted to bridge the Loup river.

A Car Wheel Foundry is to be built in Palestine, Tex., of sufficient capacity to supply the railways of Texas, Louisiana and Mexico.

Freight Cars—The St. Paul has given out a contract for the manufacturing of $400,000 worth of freight cars, cabooses, etc.

New York City Labor.—*The City Record* gives the laboring force employed on city work for the week ending July 11th, as follows: Mechanics, 271; laborers, 899; teams, 26 and carts 127.

Bridge Over the Rio Grande.—Proposals will be received at the office of the County Clerk of Costilla County, San Lius, Col., until August 31st, for a bridge over the Rio Grande at Alamosa, Col.

St. Louis Cable Road.—The work of excavation has commenced for this road under contractors Fruin, Bambrick & Co. Under the contract they must complete 1,500 lin. feet per day. The entire road bed is 34,000 feet long.

Sewers, Grading and Paving.—Proposals will be received in Cleveland, O., at the office of the Brooklyn Village Clerk, until August 22nd, for a sewer and appurtenances, and till August 18th, for grading and paving; laying 8 inch water main and fittings; and the purchase of paving, waterworks and general bonds.

Charleston, S. C. Harbor Improvement.—Gen. Gilmore reports that "on the whole the results of the operations are highly favorable," in improving the ship channels at Charleston, S. C. The jetties have already developed a scouring velocity, though they still lack several feet of the contemplated height.

Cleveland, O., Harbor.—Major L. C. Overman, reports that five-sixths of the harbor of refuge building there is completed and only $800,000 out of the $1,800,000, the original estimate of cost, is expended. Changes in the original plan will cost about $400,000, still leaving the total cost $500,000 below the first estimate.

The King Iron Bridge and M'fg. Co., of Cleveland, Ohio, secured the contract for building the bridge across the Allegheny River, between the towns of East Brady and Brady's Bend, Pa. It will be built of iron, high truss, in 4 spans, 3 of 200 feet each and one of 162 feet, with roadway of 20 feet in the clear. When completed the bridge will be operated as a toll bridge by the East Brady Bridge Co.

Bids for Laying a Water Main in Minneapolis.—Engineer Waters, Minneapolis, Minn., reported, July 30th, the following bids received for laying a six-inch main on Stevens avenue, from Twenty-sixth to Twenty-seventh streets:

John Gleason & Co., 35 cents per lineal foot; H. B. Wells, St. Paul, 28 cents per lineal foot; Fred Youngsen, 25 cents per lineal foot.

The contract was awarded to Fred Youngsen, he being the lowest bidder.

New Shops for Birmingham.—A Birmingham, Alabama, special says that President Bond, of the Cincinnati, New Orleans and Texas Pacific road has closed a contract with the Elyton land company for a valuable tract of land in that city upon which to place the shops of the Alabama Great Southern division, which will be erected immediately. Two hundred and fifty families will thus be brought to Birmingham.

The Penna. Co. Builds its own Masonry.—The Pennsylvania Company is doing a large amount of masonry work this summer. For the last ten years they have been letting out all this class of work by contract. This seems to have been a short-sighted policy, and they are now suffering from the poor work done in several instances. This summer, therefore, they have again commenced to do the work themselves.

St. Anthony's Falls.—Maj. Chas. Allen, in his report to the Chief of Engineers, says that a radical change is needed with plans for the protection of the Falls, and this would call for the removal of most, if not all, of the mill dams from the bed of the stream (some of them now leak and are liable to give way), the extension of the rolling dams from bank to bank and a large extension of the timber and concrete apron.

The Rand Drill Co.—The Lake Superior Iron Co writes to the Rand Drill Co., that while lately renewing a portion of the foundation under one of the 16"×30" Rand Compressors, the machine, put in place in 1878-9, was thoroughly examined. The steam end, in all its parts, was found in perfect repair, and only needed the setting out of the piston rings. The brass air-cylinder showed but slight wear, but it was thought best while the engine was down to counter bore it at the ends. Beyond these slight repairs "not one dollar of repairs had been made in 6¾ years." We are officially notified also, that the Rand Co. has been awarded by the New Orleans Exposition, the gold medal of the first class, for the best reciprocating rock-drill, and the gold medal of the first class for duplex air-compressors.

California Rivers and Harbors.—WASHINGTON, D. C., August 1st.—Lieut. Col. Geo. H. Mendell, Corps of Engineers, has submitted his annual report on the improvement of rivers and harbors in California under his charge to Gen. Newton, Chief of Engineers.

In Oakland Harbor, Cal. the only work contemplated during the year is the removal of 800,000 cubic yards in the tidal basin by dredging. This will absorb about $91,345 available at the end of the fiscal year. The expenditures during the year were $112,204. The project looks to obtaining a ship channel, with 30 feet of water at low and and 26 feet at high tide. The work necessary to secure this result is the continued excavation of the tidal basin, the excavation of the tidal canal, and the completion of 818 feet of the south jetty. The sum of $999,999 will be required for this purpose, of which $303,000 could be profitably expended during the next fiscal year. During the past fiscal year $17,109 were expended on the improvement of Wilmington Harbor, Cal., leaving $42,108 available. It is estimated that 250,000 will be required for the completion of the work, which it is expected will give the harbor a low-water depth of ten feet. One hundred and fifty thousand dollars is asked for the next fiscal year.

Sewers and Paving.—Proposals will be received by the Cleveland, O., Board of Improvement up to August 10th for sewers, August 12th for paving; and by the Water-Work Dept. up to Aug 6th, for fencing and bridges.

The New Croton Aqueduct.—At the stated meeting of the Croton Aqueduct Commission, on July 15th, among minor business transacted was a resolution providing for an additional shaft on Section 9, "where unforeseen physical difficulties have been disclosed;" provided that all work incidental to the sinking of this shaft shall not cost more than $5,000.

The Comptroller of the city was also requested to raise the sum of $1,000,000 required to defray the necessary and lawful expenditures of the commission for the current year.

At the same meeting the following persons were appointed Inspectors on the recommendation of the Chief Engineer:—John Kelly, Thos. J. Keogh, John S. Stevenson, George B. Francis, James Lyons, Edward O'Shea and Patrick Daly.

The Jetties.—Major Heuer, of the Corps of Engineers, has submitted his report of the progress of work on the improvement of the South Pass of the Mississippi River for the past fiscal year to General Newton, Chief of Engineers. He says: "One of the interesting facts connected with the improvement is that the full depths and widths of channels required by law have been maintained throughout the year by Mr. Eads, and that no dredging of any kind has been required on any of this work since February, 1883. No work has been done in the pass or at the head of the passes during the year. The inner east jetty has been extended 605 feet. The main jetties, where covered with concrete blocks, still continue to settle slightly, the subsidence for the year averaging a little less than two inches. Near the head of the pass in September and October of 1884 the channel shoaled to a depth of 26.4 feet, but in February following the depth increased to 33.7 feet. This has again shoaled to a depth of 30.6 feet in consequence of a falling river. The 30 foot channel at this locality is now 100 feet wide."

Index to Periodical Literature.

Arch.—*Brief Calculation for a Metal Arch.*— Treats of the method of studying the strains on arches of large span by curves of pressure. The subject is worked out by formulæ and has two diagrams. *Les Annales des Travaux Publics.* July, 1885, pp. 1386 to 1388.

Bridge.—*New Bridge and Viaduct at Cubzac, France.* Being built across the River Dordogne, on the new railway from Cavignag to Bordeaux. The bridge is 561.6 metres (1842 ft.) long, and is an iron lattice-girder through bridge; it has 8 spans, the two end ones 60 metres (197 ft.), and the other six 73.6 metres (241 ft.); the lower part of the piers is of masonry and the upper part of iron framework. The rails are 21.8 metres (78 ft. 6in.) above high water. There are 2,930 feet of iron, and 1,903 feet of masonry viaduct. The method of operations are described, and the construction of piers and superstructure. Illustrated. *Le Génie Civil.* July 11, 1885, pp. 161 to 163.

Dock.—*Construction of a Graving Dock at the Saigon Arsenal by Means of Metal Caissons and Compressed Air.*—Length inside 161 metres (528 ft.); width at bottom 19.08 metres (62 ft. 6 in.); width at top 26.88 metres (88 ft.); depth from coping to sill 9.50 metres (31 ft.) Total length 167.5 metres (549 ft. 6 in.) There are two main caissons 8.3 metres by 30 metres (27 ft. by 98 ft.) divided horizontally, the working chambers divided into 10 compartments. Granite walls. The construction, caissons, gates, pumps and plant and the arrangement of sheds are described, with notes on the strains. Illustrated. *Les Annales des Travaux Publics.* July, 1885, pp. 1382 to 1386.

Graving Dock.—(*See* Dock.)

Hydraulics.—*Hydraulic Propulsion.* Brief mention is made of early patents and experiments with a table of trials from 1867 to 1883. It deals principally with a modern English torpedo boat experimented with in comparison with a screw boat of the same class. Cylinders of the hydraulic boat 8¼ inches and 14½ inches, stroke 12 inches; of the screw boat 8¼ inches and 13½ inches, stroke 8 inches. Speed of latter nearly 50 per cent. more than that of the former. The hydraulic boat is described, and the machinery and experiments given in detail. *Engineering,* July 10, 1885, pp. 26 to 28.

Metals.—*Fatigue of Metals.* Description of a machine constructed by Prof. Egleston, by which the alterations produced by strains may be accurately measured. It was designed for ascertaining when the uncombined carbon in iron and steel would combine and render the metal brittle. The apparatus is described and illustrated, and the experiments which will be made. *Engineering,* July 10, 1885, pp. 33, 34.

Natural Gas.—*Natural Gas Fuel and its Application to Manufacturing Purposes.* A paper read by Mr. A Carnegie before the Iron and Steel Institute. Describes the early attempts to utilize this gas, and the present extent to which it is employed. The methods of operation are described; holes about 8 inches diameter at top, and 4 inches at bottom. Pressure at wells averages 200 pounds, and at works, 9 miles distant, 75 pounds. Cost per mile for piping and right of way $75,000. *Engineering,* July 10, 1885, p. 36.

Permanent Way.—*Resistance of the Permanent Way to Vertical Strains.*—The action of a locomotive at full speed is considered, when the weight on its wheels is constantly varying owing to the oscillations due to irregularities of the track, and the working of its own machinery. Notes of several experiments are given. The action of the forces on rails, ties with and without chairs, and on the ballast and subgrade is considered. Several forms of chairs are illustrated. By M. Michel, chief engineer Paris Lyons and Mediterranean Ry. *Revue Générale des Chemins de Fer.* May, 1885, pp. 279 to 294.

Rails.—*Poor Steel Rails.*—Deals with the tendency of rails of poor quality to "flow" at the ends under traffic, the metal being too soft. Ordinary tests, it is suggested, would show this defect, and it is pointed out that more care should be taken in purchasing rails. *Railroad Gazette.* July 24, 1885, p. 471.

Rolling Stock.—*Types for Rolling Stock of Secondary Railways of Standard Gauge.*—Designed for the Prussian State Railways. They include 6 types of passenger cars, two of baggage and postal cars and two locomotive tenders. All on two axles, wheel-base from 4 to 5 metres (13 ft. to 16 ft. 6. ins). Iron underframes. Transverse seats with central passage, end platforms, and spring buffers. Bodies about 26 feet long, by 10 feet wide, by 6 feet high and 7 feet high in the middle. Heated by stoves, lighted by gas—in some cases oil or wax, and fitted with ventilators. Heberlein chain brake. The cars are fully illustrated and described, and a table of dimensions is given. *Revue Générale de Chemins de Fer.* May, 1885, pp. 295 to 304.

Steam Engines.—*Long and Short Stroke Engines.*—Two engines are selected as types for comparison; long stroke engines are those with ratio of strokes to diameter of cylinder 2½ or 3 to 1; short stroke engines 1, or less, and 1½ to 1, piston speed practically the same. Claims that with short strokes the steam shows by the indicator diagram that it acts more efficiently, and consequently more economically and points out that locomotive and marine engines are usually short stroke. *Journal of the Assoc. of Eng. Soc.,* July 1885, pp. 350 to 356.

Traction.—*Comparative Studies of Various Methods of Traction Applicable to Railways.*—A brief abstract of an exhaustive article in "La Lumiére Electrique," vol. xv. It is divided under several heads, but the abstract deals principally with the theoretical points of carrying the current to the motor, and the arrangement of wires or rails for the same. *Min. Proc. Inst. C. E.,* vol. lxxxi. Session 1884-85, part 3.

Viaduct.—(*See* Bridge.)

Market Report of Engineering Materials.

New York, August 6, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	1.9c. @	2.2c.
Tee	2.2 @	2.4c.
Beams and channels	3.0c. @	
Tank	2. @	2.1c
Shell	3c. @	3¼c
Steel plates, Tank	2¾c. @	3c.
WROUGHT-IRON PIPE.. PITTSBURGH.		
Butt welded, black.....Discount	45 @	50
" " galvanized..... "	35 @	40
Lap welded black..... "	65c. @	
" Galvanized..... "	45 @	50
Boiler tubes..... "	60 @	
RAILS.		
Steel (large lots at mill)	$27.00 @	27.50
Old rails	16.50 @	17.00
Old rail steel	16.50 @	17.00
R. R. spikes	1.8 @	1.9c
R. R. splice-plates	1.55 @	1.7
R. R. Track Bolts	2.55 @	2.65
Barb-wire fencing, galvanized	4¾c. @	5¾c.
" " painted	3¾c. @	4¾c.
Corrugated iron		
Nails		
Iron	2.25	
Steel	2.40	

METALS.

COPPER.		
Lake Superior	11. @	11¼
Other Brands	10¾ @	11⅛
LEAD.		
Com. Domestic	4.12½ @	4.15
Lead Pipe	.05¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	0.05 @	0.05¼

BRICK.

(Cargoes afloat)		
Haverstraw.....per M.	$6.25 @	6.50
Fishkill		
Up-River	5.50 @	6.25
Jerseys	5.25 @	6.00
Long Island		
" pale	3.00 @	3.50
FRONTS.		
Croton red	13.00 @	14.00
" dark	13.00 @	14.00
" brown	12.00 @	13.00
Philadelphia pressed	24.00 @	25.00
Trenton "	24.00 @	25.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	65.00 @	130.00
" American	85.00 @	120.00
Fire brick	25.00 @	40.00

CEMENT.

PORTLAND.		
Gibb's English 400 lbs. per bbl	2.75 @	2.90
K. B. & S. " "	2.85 @	3.00
J. B. White & Bros., Portland Cement	2.65 @	3.00
do Keene's Superfine,	8.00 @	10.00
do " Coarse,	5.00 @	6.00
Roman	2.75 @	3.50
Largerdorfer German "	2.55 @	2.80
Dyckerhoff, " "	2.90 @	3.25
Stettiner " "	2.60 @	2.65
Hanover " "	2.60 @	2.65
Vorwohler, Lion "	2.90 @	3.25
Alsen, " "	2.55 @	2.60
Fieve "	2.40 @	2.50
Saylor's American	2.15 @	2.40
Windsor } U. S. C. Co.	1.00 @	1.10
Standard } U. S. C. Co.		1.15
Cable's Portland	2.15 @	2.40
ROSENDALE cements	1.00 @	1.10

LIME.

Rockland common per bbl	1.00
" finishing	1.20
State, common	.90
" finishing	1.10
Kingston, ground	0.95
Add 25c. to above figures for yard rates.	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90 @	95
" " No. 2 "	0.75 @	0.80
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "	0.75 @	1.00
Brownstone, Portland, Ct. "	1.00 @	1.30
" Belleville, N. J. "	0.75 @	1.25
Granite, rough	0.60 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00 @	20.0
Choice	55.00 @	80.
Tally plank, 1¼ in. 10 in. dres'd, each.	.44 @	.50
Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2½ × 4 to 4 × 6 in	.17 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	25.00 @	30.00
Dressed flooring "	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75 @	6.00
LATH, Cargo rate "	2.10 @	2.25

PAINT.

Lead, white, American dry per lb	.04¾ @	.05
" " in oil pure "	.05¼ @	.05¾
English, B. B. in oil	.08½ @	.08¾
Red, American	.05½ @	.05¾
Litharge "	.05 @	.05¼
Venetian red, American "	.01 @	.01¼
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11¼
Paris green "	.15 @	.19
Umber, Amer. raw and powdered per lb.	.01¼ @	.01½
Drop black, Amer. "	.08 @	.12
" " "	.09 @	.11¼
Chrome green	.05 @	.15
Oxide zinc, American	.03¼ @	.04
" French	.06¼ @	.06½

Granite Block Paving.—The Public Works Dept. of New York City, will receive proposals until August 11th, for granite block paving; street grading and paving, laying water-mains; repairs to 42nd street reservoir; and furnishing lumber. The Docks Dept. will receive till same date, proposals for a building on Pier A, N. R.